
Meridian 1

Nortel COMPANION Microcellular

Site planning and deployment guide

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Contents

Revision history	iii
Introduction to Microcellular site planning and deployment	
1	
Site planning and deployment procedure	2
Microcell concepts	3
Microcell and macrocell distinctions	4
Underlay	4
Service area	4
Cell	6
Radio protocols	6
Frequency reuse plan	7
Interference	7
Control-channel interference	8
Adjacent channel interference	8
Co-channel interference	8
Interference from macrocell mobiles	8
Path loss	9
Distributed antenna structure	10
Traffic concepts	12
Intensity	12
Busy hour	12
Blocking	12
Grade of service	12
Erlang B tables	13

Microcellular system hardware and software components	13
Meridian 1 Core software	17
Multipurpose ISDN Signaling Processor (MISP)	17
Embedded Intelligent Mobility Controller (EIMC)	18
Microcellular Transcoder Card (MXC)	19
Microcellular Base Station (MBS) with radios	20
Distributed antenna system	23
Hybrids	26
Dual 8-Port Hybrid	26
Quad 4-Port Hybrid	26
Automatic Frequency Planning Station (AFPS)	27
Microcellular portables	28
Meridian Administration Tool (MAT)	28
Cellco Mobility Control Point (CMCP)	30
Microcellular system capacity	31
Multi-Site Networking	32
Meridian 1 SL-1 or third-party PBX connectivity	32
 Preliminary design overview	 35
Producing a preliminary design and quote	35
Completing the Microcellular Customer Information Form	36
 RSSI Readings	 37
Recording measurements	38
Placing the portable in test mode	38
Taking RSSI readings	40
Choosing measurement locations	41
 IMCS antenna simulation	 43
Preparing to run a simulation	44
Running an IMCS simulation	45
Input parameters	49
Building information	49
Cable type	49
RF characteristic information	49

Result Storage	50
Simulation Grid	51
Antenna information	51
Antenna type	51
Antenna position and orientation	52
Antenna connections	53
Simulation execution	54
Simulation results	54
Estimated RSSI	54
Coverage result	56
Examining IMCS results	57
Preliminary design and equipment list	59
Traffic calculations	62
Antenna arrays	65
Antenna array with no hybrid	65
Antenna array with one hybrid	66
Antenna array with two hybrids	67
RF cable count	69
Dual 8-Port Hybrids	69
Dual 8-Port Hybrid count	69
Terminator count for Dual 8-Port Hybrids	70
Quad 4-Port Hybrids	70
Quad 4-Port Hybrid count	70
Terminator count for Quad 4-Port Hybrids	71
Coaxial cable	71
Cable types	71
Cable standards	71
N-style male coax connector count	72
TRU-IIs	72
Microcellular Base Stations (MBSs)	72
MBS count	72
MBS terminator count	73
Automatic Frequency Planning (AFP) Stations	73
Meridian 1 Microcellular hardware	74
Preliminary equipment list	75

Prerequisite Meridian 1 hardware and software	75
System packages for Microcellular systems	77
Antenna system hardware	79
Radio system hardware	79
AFP hardware	80
Additional Microcellular parts	81
Coaxial cable and connectors	83
Preliminary design report and quote	85
Detailed design overview	87
Microcellular deployment tools	89
Signal source	89
Receiver	89
Antennas	90
Laptop computer	90
Measuring wheel	90
Accessories	90
Microcell Deployment Data Collection (MDDC) ..	91
Setting up the test equipment	92
Initializing a Microcellular design project	92
Measuring control-channel interference	94
Measuring path loss	95
Verifying RF coverage by scanning	97
Checking battery status	98
Calculating frequencies	98
Design Verification	99

Antenna placement and cabling	101
Elevator shafts	105
Coverage gaps	105
Estimated cable lengths	106
MBS and hybrid placement	111
TCM wiring	117
Connectivity	119
AFP Station placement	121
Final equipment list	125
Antenna systems	125
Microcellular Base Stations	126
Automatic Frequency Planning (AFP) Stations	126
Meridian 1 Microcellular Cards	128
Portable telephones	128
Spare parts	128
Antenna installation tools	129
Deployment plan and configuration	131
Appendix A: Customer Information Form	133
Appendix B: MBS to antenna tables	143
List of terms	147
Index	159

List of figures

Figure 1	
Microcellular deployment process	3
Figure 2	
Service area and cells	5
Figure 3	
Omni versus distributed antennas	11
Figure 4	
Microcellular system model (Options 51C, 61C, 81, and 81C)	15
Figure 5	
Microcellular system with serial connection to AFP Station	16
Figure 6	
MBS	21
Figure 7	
MBS-Exploded view	22
Figure 8	
Directional antenna (A0609534)	24
Figure 9	
Omni antenna (A0659298)	25
Figure 10	
Dual 8-Port Hybrid	26
Figure 11	
Quad 4-Port Hybrid	27
Figure 12	
Nokia portable programming menu	39

Figure 13	
Nokia Field test menu	39
Figure 14	
Nokia portable test mode display	40
Figure 15	
Process flow chart	45
Figure 16	
IMCS Coverage window	46
Figure 17	
IMCS Placement Configuration window	47
Figure 18	
Two-segment piecewise linear model	50
Figure 19	
Grid size input	51
Figure 20	
Antenna information	52
Figure 21	
Antenna main-beam direction reference	53
Figure 22	
Placement example for directional antenna	53
Figure 23	
IMCS color table	55
Figure 24	
Color plot of estimated RSSI	55
Figure 25	
Configuration for one to four antennas	66
Figure 26	
Configuration for 5 to 8 antennas	67
Figure 27	
Configuration for 9 to 16 antennas	68
Figure 28	
Microcell Deployment Data Collection (MDDC) main menu	93

Figure 29	
Antenna drawing conventions	102
Figure 30	
Antenna positioning requirements	103
Figure 31	
Example antenna locations	104
Figure 32	
Cable length estimate for example job—fourth floor	108
Figure 33	
Cable length estimate for example job - third floor	109
Figure 34	
MBS power cord and cable length	112
Figure 35	
Floor mount MBS Installation requirements	113
Figure 36	
Wall mount MBS installation requirements	114
Figure 37	
MBS floor mount with hybrid	116
Figure 38	
AFPS locations near stronger RSSI readings	122

List of tables

Table 1	
TRU-II and antenna combinations	23
Table 2	
Coverage	56
Table 3	
Erlang B model—blocked calls cleared	63
Table 4	
Additional parts	81
Table 5	
Andrew cables and connectors	84
Table 6	
Part numbers for two terminators	84
Table 7	
Suggested MBS TCM and Meridian 1 MXC port connections	118

Introduction to Microcellular site planning and deployment

The Nortel COMPANION Microcellular system provides both in-building and wide area mobility, using a single, standard cellular portable. The Microcellular system is fully integrated within a Meridian 1 system, so users have access to a number of popular Meridian 1 features on their portables while in-building.

The Microcellular system supports the IS-136 and IS-54B radio protocols. A Release 23 system supports TDMA-3 ACELP (Algebraic Code Excited Linear Predictive), a method of implementing EFRC (Enhanced Full Rate Codec) in IS-136 systems. ACELP implements the IS-641 protocol to provide toll-line voice quality. A Microcellular system can also use VSELP (Vector Sum Excited Linear Predictive) for voice encoding.

This section describes the site planning and deployment procedure for a Nortel COMPANION Microcellular system, presents some cellular and traffic concepts that apply to Microcellular design, and describes the Microcellular hardware and software components. For a complete overview of the Microcellular system, see the *Nortel COMPANION Microcellular Overview* (553-3611-100).

Site planning and deployment procedure

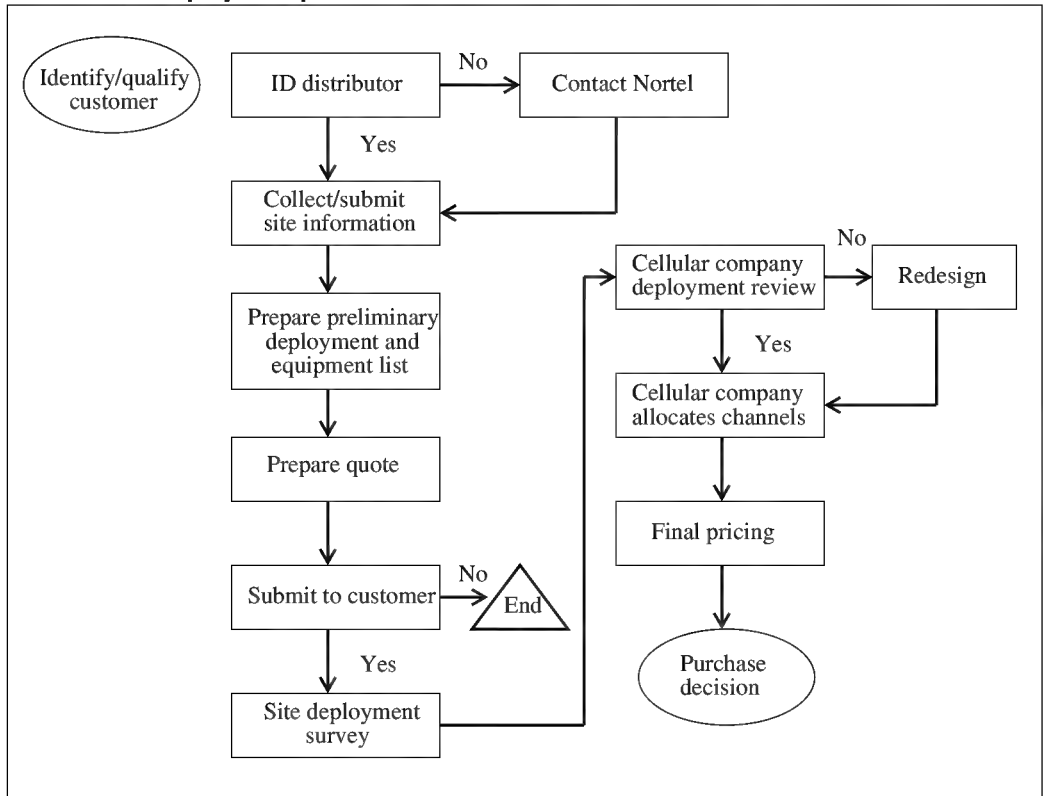
The site planning and deployment procedure for a Microcellular system follows:

- 1 The customer completes the Microcellular Customer Information Form (Appendix A), with the sales representative, who returns the form to the Meridian 1 authorized distributor.
- 2 The sales representative or sales support engineer takes preliminary Received Signal Strength Indicator (RSSI) readings at the customer site and sends the RSSI readings to the distributor.
- 3 The distributor gives the Customer Information Form and the RSSI readings to the site planning engineer, along with floor plans, if available, for the proposed Microcellular site. The distributor can request site planning services from Nortel.
- 4 The site planning engineer runs the IMCS software, an MS Windows™ 3.1 application, on a PC to simulate and analyze a distributed antenna system for the proposed Microcellular system.
- 5 The site planning engineer uses information from the IMCS simulation, the RSSI readings, and the Customer Information Form to prepare a preliminary design and equipment list for the site planner.
- 6 The site planner uses the preliminary design, preliminary equipment list, and Meridian Configurator to prepare a preliminary design report and quote for the customer.
- 7 When the customer accepts the quote, the site planner makes a site visit with deployment tools to take accurate RSSI readings, to run the Microcell Deployment Data Collection (MDDC) software (an MS Windows 3.3 application), and to perform detailed deployment and provisioning. As an alternative, the distributor may purchase this service from Nortel.
- 8 The site planner prepares a final equipment list and detailed design documents for the Microcellular system installation and maintenance.
- 9 The cellular service provider reviews the deployment design.
- 10 If necessary, the site planner redesigns the Microcellular system deployment until the cellular service provider approves the design.

- 11 The cellular service provider allocates channels for the Microcellular system.
- 12 The site planner submits the final design and pricing information to the distributor for the customer to make a purchase decision.

Figure 1 illustrates this deployment process.

Figure 1
Microcellular deployment process



Microcell concepts

This subsection covers some microcell concepts that apply to site planning and deployment. To understand these concepts, you need some basic understanding of telephony, radio frequencies (RF), and cellular systems.

Microcell and macrocell distinctions

The original TIA-553 industry standard that defines the Common Air Interface for cellular systems implicitly assumed that all mobile telephones would be carried in vehicles, covering large distances quickly, and that the user density would be fairly low. Cells designed to these assumptions tend to be large, with a lower size limit of about a mile. This describes existing cellular systems. To differentiate these cells from the much smaller microcells, we call them macrocells.

Microcells are typically very small, 20 ft to 300 ft across. All of the mobiles operating within a Microcellular system are hand-held portables (pedestrian traffic) and therefore move slowly and have very low power output. Cells in a Microcellular system are deployed indoors. Indoor microcells generally exist as an underlay to an existing cellular system.

Underlay

An underlay is a cell that exists within the coverage area of another larger cell, rather than adjacent to it or completely away from it. The fact that the microcell underlays a larger macrocell profoundly influences the design of Microcellular systems because of the special care required to avoid interference between the macrocells and microcells.

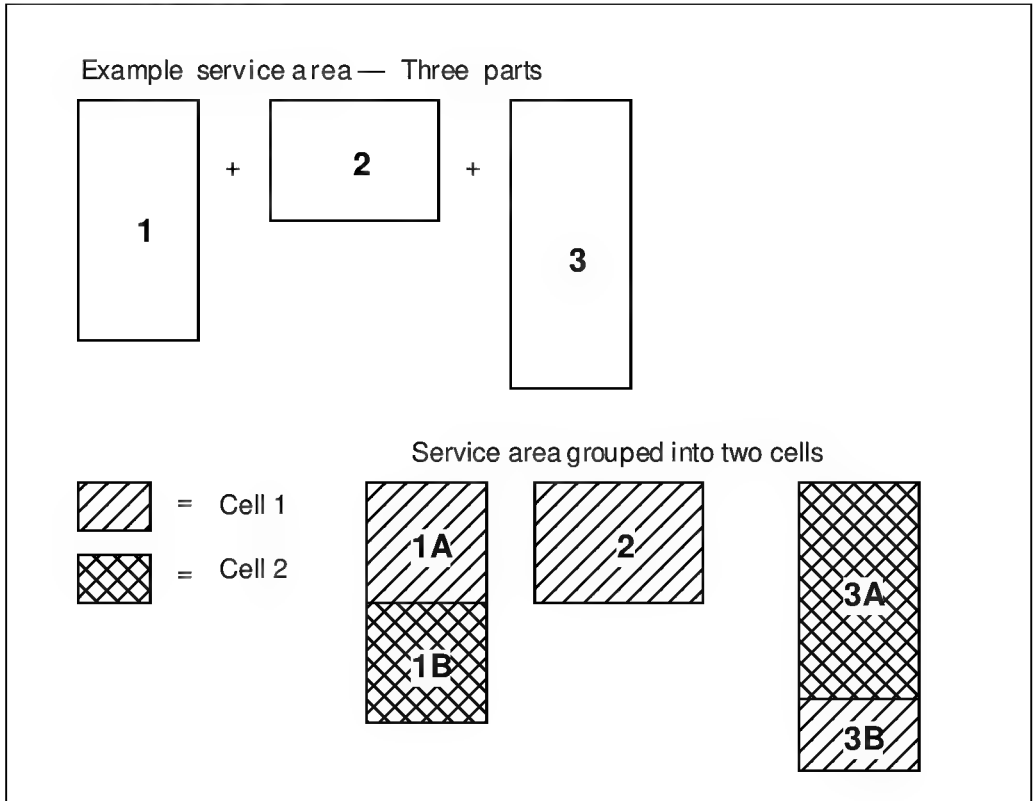
Service area

The service area is the building space served by a Microcellular system. It can span multiple floors. In the case of closely connected buildings, it can even span buildings. The service area need not be contiguous spaces; breaks or open spots are allowed within the service area.

Note: Microcellular system deployment in tall buildings (typically above 10 stories) requires early evaluation.

Figure 2 depicts a service area divided into cells. The cells can be different areas on the same level, different floors, or even adjacent buildings.

Figure 2
Service area and cells



Cell

A cell is the total area served by a single control channel, which provides signaling. The cell has the following engineering limits:

- A maximum of 16 antennas
- A maximum of 4 Microcellular Base Stations and 15 TRU-IIs
- The same Embedded Intelligent Mobility Controller (EIMC) serving all MBSs in the cell
- Maximum cable lengths depend on the MBS output power and the signal loss (attenuation) of the cable. The minimum signal level is 0 dB at the antenna end of the cable. Nortel recommends 1/2 in. coaxial cable.

The forward channel in a cell is for MBS to portable communication, using a downlink as the signal path.

The reverse channel in a cell is for portable to MBS communication, using an uplink as the signal path.

A cell supports either the IS-136 radio protocol or the IS-54B radio protocol at a given time. All portable telephones that operate in the same cell must conform to the same radio protocol.

Radio protocols

A portable telephone in a Microcellular system conforms to the IS-136 or IS-54B (dual-mode AMPS/TDMA) Common Air Interface (CAI) radio protocol. Each portable device communicates with the Microcellular system via the air interface.

In an IS-136 cell, the following radio frequency (RF) rules apply:

- The C/I interference must be 17 dB greater than the macrocell signal at that location.
- For an uplink or downlink, the minimum Received Signal Strength Indicator (RSSI) must be -85 dBm.
- The control channel for the microcell must be a minimum of two control channels away from the strongest macrocell channel.

In an IS-54B cell, the following RF rules apply:

- The microcell must have a signal strength that is 3dB to 5dB greater than the signal strength of the macrocell.
- All of the IS-136 rules apply.

Frequency reuse plan

The cellular operator provides the microcell voice and control channels. The frequency reuse plan of a cellular system describes how to allocate radio channels to cells to minimize interference problems. The cellular operator divides the available channels into groups, with individual members of the groups separated widely enough to prevent interference within the group. The cellular operator then assigns the groups to cells so that adjacent cells do not reuse the same set of channels.

In a Release 23 Microcellular system, the Automatic Frequency Planning (AFP) feature helps the cellular operator maintain the frequency plan. AFP monitors forward and reverse channels, maintains a list of usable cellular frequencies, and warns the operator if sufficient unused channels are not available. The AFP feature reduces the probability of interference with the macrocellular system because AFP automates the Microcellular system's response to macrocellular retuning.

Interference

Because a Microcellular system underlays a macrocell, interference is a key consideration in design. The types of interference most critical to the design of a Microcellular system follow:

- Competition for mobiles between the overlaying macrocell control channel and the microcell control channel (control-channel interference)
- Adjacent channel interference between the overlaying macrocell voice channels and the microcell voice channels
- Co-channel interference between macrocell voice channels (in the cell adjacent to the one overlaying the Microcellular system) and the microcell voice channels
- Interference of mobiles using the overlaying macrocell while traveling through the Microcellular system (the “near-far problem”)

Control-channel interference

Before you deploy the Microcellular system, you need to estimate or measure the level of control-channel interference.

An IS-54B portable scans the control channels, as part of power-up initialization, and tunes to the strongest control channel. The portable also does this as a part of any call attempt or page response and as part of autonomous registration. A cell's coverage area is the area in which its control-channel signal is stronger than all the other control channels present.

You can configure an IS-136 portable to scan for the Microcellular control channel first.

Adjacent channel interference

Interference between two adjacent channels, like Channel 1 and Channel 2, is adjacent channel interference. The frequency plan of the Microcellular system minimizes adjacent channel interference by avoiding channels near the overlaying macrocell channels.

Co-channel interference

Interference between two channels of the same frequency is co-channel interference. The potential for co-channel interference exists in all cellular systems because the frequency plan reuses channels already used in other cells. As with adjacent channel interference, the Microcellular frequency plan is designed to minimize co-channel interference. Channel selection to minimize co-channel interference in Microcellular systems is more difficult than for macrocell design. This is because the Microcellular channels are "borrowed" from macrocells adjacent to the overlaying macrocells (in contradiction to the original system frequency reuse plan), instead of being reused from a distant cell.

Interference from macrocell mobiles

A problem mainly in systems with relatively low control-channel interference, macrocell mobile interference stems from the low power settings used by Microcellular mobiles to prevent them from interfering with outside mobile calls. If a macrocell mobile originates a call outside the building and then drags its call into the Microcellular system, the macrocell mobile could transmit up to full power (600 mW).

While indoors, the macrocell mobile is likely to be partly shielded from the macrocell base station, which causes a decrease in the strength of the signal received by the macrocell, which then instructs the mobile to increase power.

For deployment of an IS-136 microcell, place antennas to provide -85dBm coverage near the outside walls.

For deployment of an IS-54B microcell, the optimal distance from the outside walls for directional antennas depends on macrocell interference levels. A microcell in a high-interference area requires antennas closer to the building edges than for a microcell in a low-interference area.

Path loss

Path loss is the attenuation of the radio signals from the transmitting antenna to the receiving antenna. Path loss in Microcellular systems can be roughly divided into two components. One comes from simply getting further from the antenna. The other comes from absorption, scattering and reflection of radio waves by obstacles between the transmitter and receiver. In some applications, the floor and the roof reflect the radio waves to the receiver so that the path loss is very low. In other applications the contents of the building (like walls or equipment) absorb, scatter or reflect the radio waves, producing very high path losses.

Building use is a good indicator of path loss. Some manufacturing facilities with metal roofs and large open spaces exhibit very low path losses. Some warehouses filled with high stacks of material exhibit very high path loss. Path loss is a consideration in designing a Microcellular system for sites such as the following buildings:

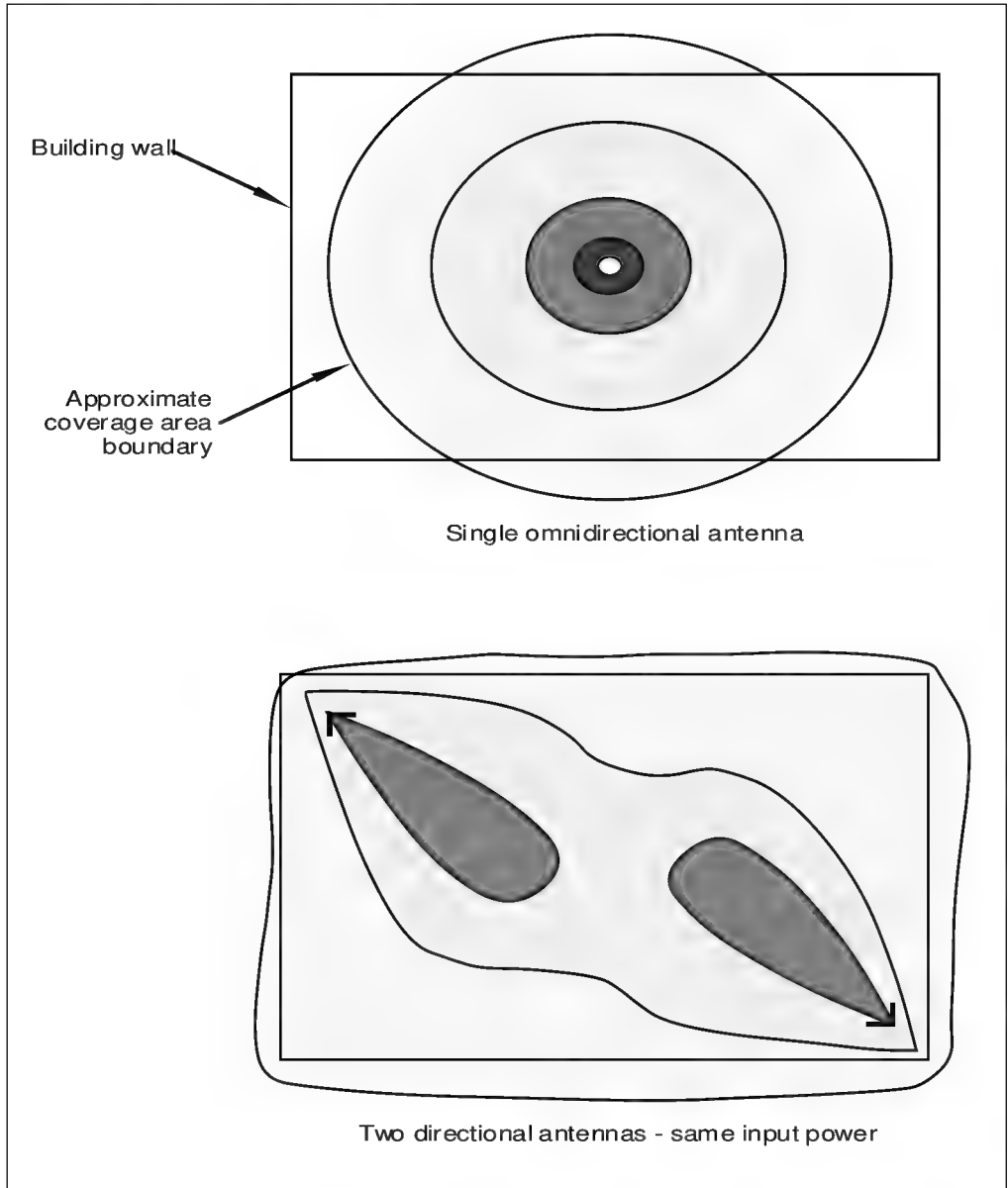
- Warehouses
- Manufacturing plants
- Athletic stadiums
- Aircraft hangars

Distributed antenna structure

A Microcellular system uses a distributed antenna structure to enable all voice channels in a cell to appear at all antennas within the cell. The simulcasting system allows more uniform coverage of larger areas than single-antenna systems in interference-limited environments like a Microcellular system. It also provides flexibility by ensuring that as users congregate in specific locations, voice channels are dynamically allocated for use where needed.

Figure 3 illustrates omnidirectional versus directional antenna patterns. Use of an omnidirectional antenna can lead to coverage holes in the corners of a building or significant spill-over beyond the building walls. Using the same power level as the omnidirectional antenna, the two-antenna multicasting system is more evenly distributed and directed into the building interior, increasing coverage without increasing spill-over and potential interference. More antennas would increase the size of the covered area.

Figure 3
Omni versus distributed antennas



Traffic concepts

The following concepts are important for traffic measurement:

- Intensity
- Busy hour

Intensity

Traffic can be measured either as an absolute (total usage) or as an intensity (the amount of usage over a given time). Intensity is the measure used for traffic engineering, and its units are typically the Erlang (1 hour of usage per hour) or the ccs (centum-call-second, or one hundred seconds of usage per hour). One Erlang equals 36 ccs.

Busy hour

The busy hour is the one-hour period of a given day that has the highest average traffic intensity on a given device group. Typically, you engineer the Microcellular system with sufficient capacity for the worst case—the busy hour. You usually engineer each cell separately to achieve the system objectives on a per-cell basis. You might choose to engineer for an average busy hour, such as the average of the ten highest busy hours over a three-month period, or for a worst-case busy hour, such as the highest busy hour of a particular month.

Blocking

Blocking occurs when someone attempts a call and cannot get through because all of the radios in the cell are busy. System performance objectives are generally stated in terms of the amount of blocking (the proportion of callers who are blocked) that you will permit during the busy hour.

Grade of service

The grade of service is a measure of the probability that a call offered to a given cell will not find an idle voice channel on the first attempt; that is, that any given call will be blocked. In this document, the grade of service is expressed as a percentage; for example, a 1% chance (probability) that all voice channels will be busy and the call will be blocked.

Erlang B tables

The Erlang tables are derived from formulas that summarize the theoretical work on telephone traffic statistics. The “B” formula (from which the Erlang B tables are derived) assumes that a blocked call is cleared; that is, the caller does not try again during the busy hour. For a Microcellular system, the “B” formulation for cell sites is used. The Erlang B tables give the traffic capacity of a cell as a function of the number of members in the cell and the desired grade of service (blocking) for the cell. Table 3 on page 63 lists Erlang B values that are relevant to Microcellular engineering.

Microcellular system hardware and software components

A Microcellular system has the following hardware and software components:

- Meridian 1 Core software
- Multi-Purpose ISDN Signaling Processor (MISP)
- Embedded Intelligent Mobility Controller (EIMC)
- Microcellular Transcoder Card (MXC)
- Antenna array and hybrids (combiner/splitters)
- Microcellular Base Station (MBS), including TRU-II's
- Automatic Frequency Planning (AFP) Station and either of the following:
 - Meridian Communications Unit (MCU)
 - A pair of short-haul modems for each AFP Station
- Microcellular portables
- Meridian Administration Tool (MAT)

A Release 23 Microcellular system requires Mobility System Management (MSM) with the AFP feature on a local (on-site) MAT (running MAT 5.7+ software). The distributor might still choose to manage the site through an additional, remote MSM MAT.
- CMCP (Cellco Mobility Control Point) application on a MAT

A Microcellular system also includes the following logical components:

- Subsystem
- Zone
- Cell
- AFP region
- Neighbor cell

Figure 4 illustrates the hardware components of a Release 23 Microcellular system.

Figure 4 illustrates the hardware components of a Release 23 Microcellular system with a serial connection to an AFP Station.

Figure 4
Microcellular system model (Options 51C, 61C, 81, and 81C)

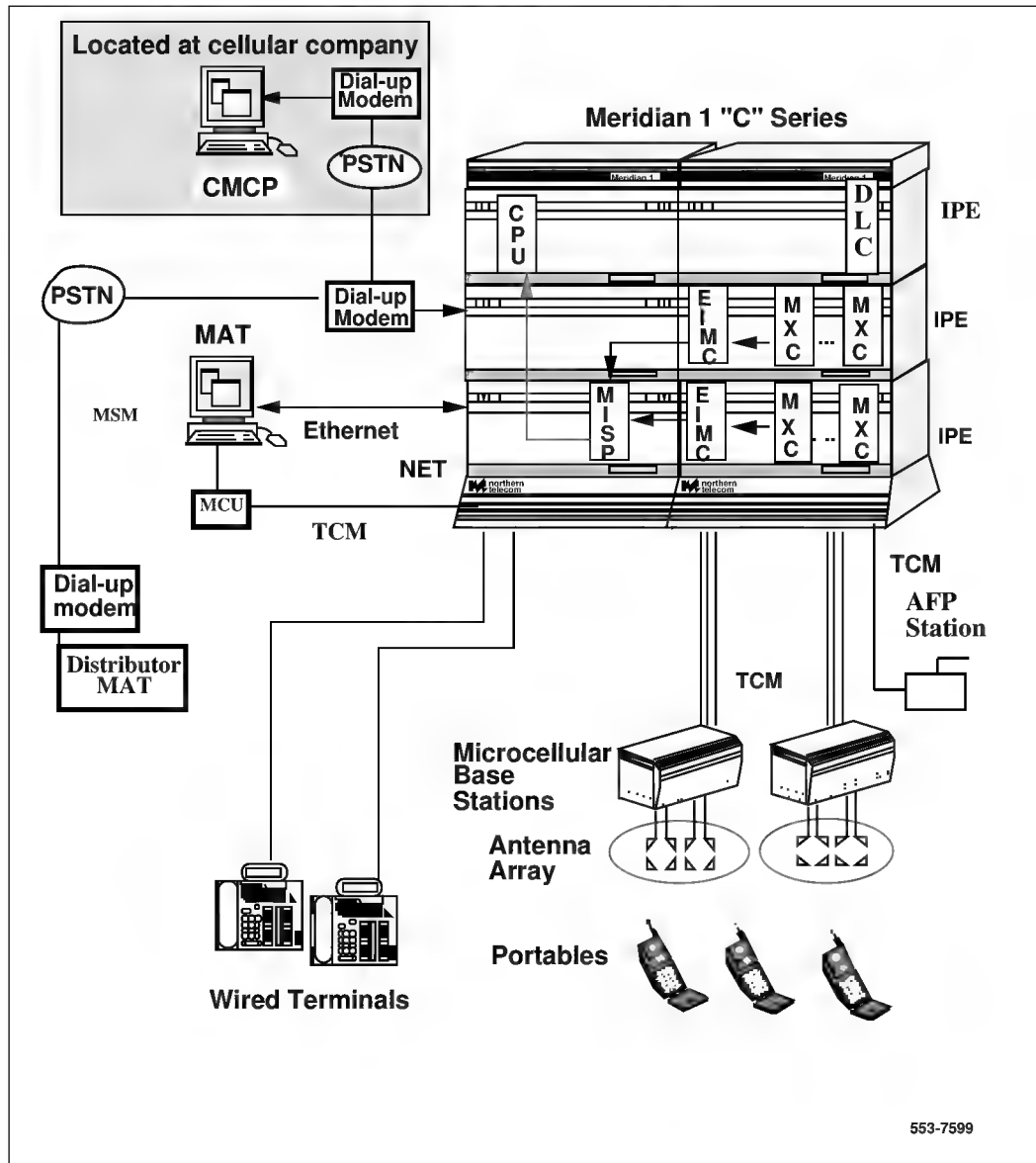
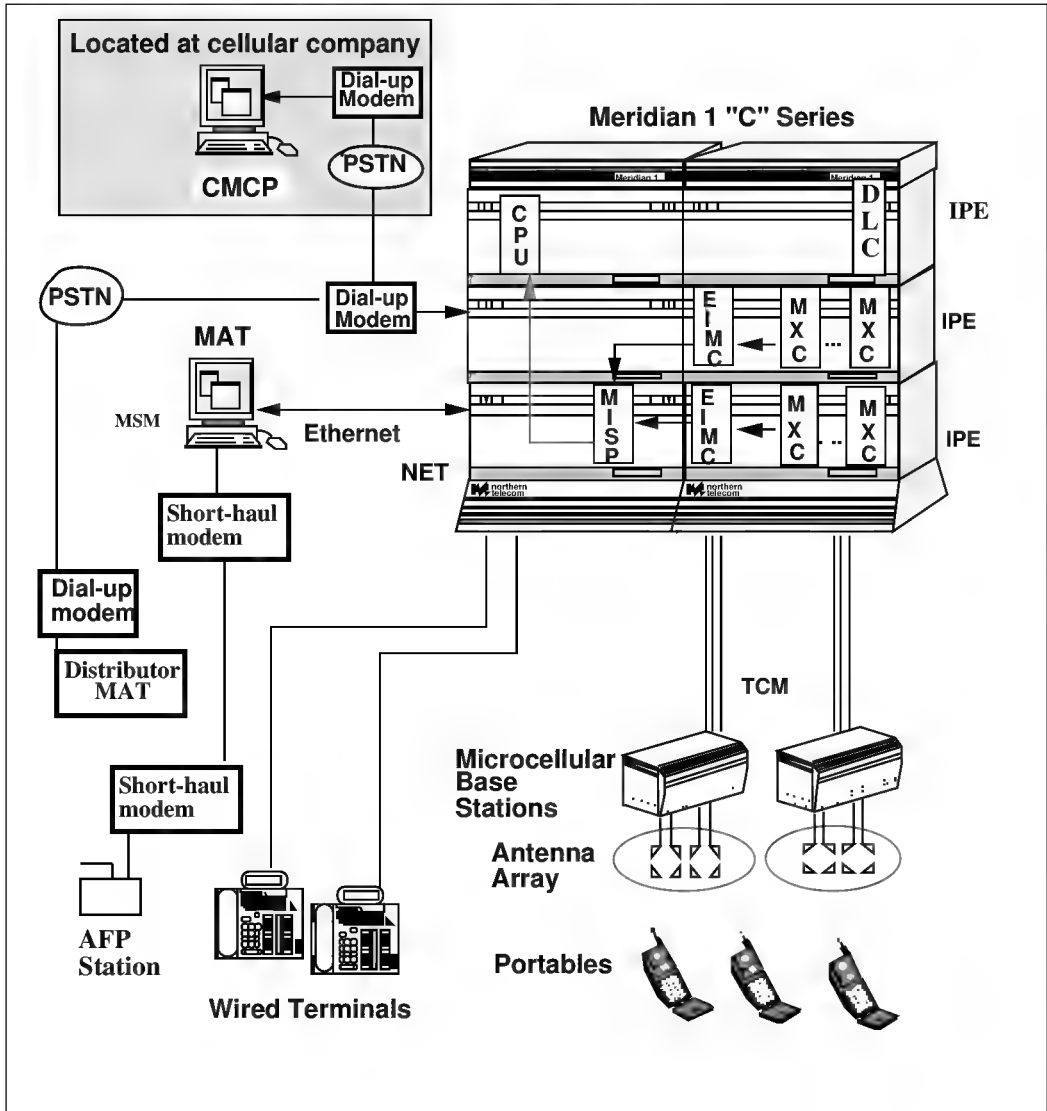


Figure 5
Microcellular system with serial connection to AFP Station



Meridian 1 Core software

The Meridian 1 Core software provides access to call control, call control services, and Meridian 1 set features for portables. Meridian 1 Core software provides call processing and switching capabilities for portables, so that portables can originate as well as receive voice calls. It also provides switching for call handoffs.

Meridian 1 Core software also extends a subset of existing Meridian 1 features, such as Call Forward All Calls and Transfer, to portable users for greater call management and convenience. For a list of these features, see the *Nortel COMPANION Microcellular Overview* (553-3611-100).

The Object Request Broker (ORB), part of the core software, provides the means through which object-oriented applications, or objects within object-oriented applications, can communicate by sending messages to each other rather than by sending messages through an IPC (interprocess communications) mechanism.

Multipurpose ISDN Signaling Processor (MISP)

The MISP provides routing and message relays between a Meridian 1 CPU and an Embedded Intelligent Mobility Controller (EIMC). One MISP can serve up to eight EIMCs.

A Microcellular system in an Option 51C, 61C, 81, or 81C system must use an MISP dedicated to the Microcellular system. In Option 11C, the MISP is not required because the EIMC can access the CE/MUX bus directly.

In Options 51C, 61C, 81, and 81C, the MISP provides a high-speed and high-bandwidth signaling path between cards on the peripheral shelf and the Meridian 1 CPU. The MISP sits directly on the CPU BUS and has “shared” memory-based communications with the Meridian 1 CPU.

The EIMC communicates with the Meridian 1 CPU through the MISP. A timeslot connection is nailed up between the EIMC and the MISP. The MISP Base Code and the Mobility Routing Application (MOB) provide the communications pipe between the EIMC circuit pack and the Meridian 1 CPU.

The MISP also provides relay and routing functions for the EIMC-to-EIMC communications needed for multi-EIMC systems or for Multi-Site Networking in Options 51C, 61C, 81, and 81C.

Embedded Intelligent Mobility Controller (EIMC)

The EIMC is the wireless controller for the Microcellular system. The EIMC handles all messages for call processing, location tracking, and intrazone and interzone handoffs. It also handles signaling among itself, the MISP pack, and the MXCs.

In an Option 51C, 61C, 81, or 81C system, the EIMC can be in any available IPE slot. In an Option 11C system, the EIMC must reside in the main cabinet.

Each EIMC on an Option 51C, 61C, 81, or 81C system controls up to 15 Microcellular Transcoder Cards (MXCs) on the same IPE shelf. A Microcellular system can support a maximum of 15 MXCs per IPE shelf. For a VSELP-only system, up to 12 MXCs per superloop may be configured. Each Option 51C, 61C, 81, or 81C system can include one or more EIMCs (one EIMC per IPE shelf).

To eliminate local switching conflicts, each Option 11C system is limited to one EIMC (in an IPE slot in the main cabinet), and each Option 51C, 61C, 81, and 81C system can include one or more EIMCs (a maximum of one EIMC per IPE shelf). Each EIMC provides the Microcellular functions for one zone.

EIMC software provides the following functionality for control, access, and management of the IS-136 and IS-54B Common Air Interface (CAI) radio protocols:

- IS-136 or IS-54B Protocol Stack (part of layer 3 protocol processing)
- Frequency Management
- Resource Management
- Portable Locating
- Server OA&M

The EIMC communicates with TRU-IIs via the nailed-up TCM connection from the MXC that serves the TRU-IIs. The EIMC manages TRU-II frequencies and timeslot assignments on those frequencies. It also determines when a handoff is necessary, by processing RSSI (Received Signal Strength

Indicator) measurements from the TRU-IIs using Mobility-Assisted Hand-Off (MAHO) messages from the portables. The EIMC requests system resources as needed from its Abstract Switching Interface.

Microcellular Transcoder Card (MXC)

The MXC provides transcoding of voice within the Microcellular system. In an Option 51C, 61C, 81, or 81C system, an MXC must be configured on the same IPE shelf with the EIMC that controls the zone that the MXC serves and with the other line cards. In an Option 11C system, an MXC can reside in the main cabinet with the EIMC or in an expansion cabinet.

For ACELP/VSELP with a digital control channel, the MXC provides four TCM loop interfaces to the Microcellular Base Stations (MBSs). For VSELP, the MXC provides eight TCM loop interfaces to the MBSs. Each MBS uses up to four TCM interfaces (one per TRU-II). Each TCM interface is two wires (single twisted pair). Across this interface, the MXC does not provide loop powering—local power is required.

The MXC provides both TDMA-3 ACELP service and TDMA-3 VSELP service. ACELP implements the IS-641 protocol to provide toll-line voice quality.

An MXC can support one control-channel radio and up to seven traffic-channel radios for VSELP service or one control-channel radio and up to three traffic-channel radios for combined ACELP/VSELP service. Mobility System Management enables users to configure the MXC either as an ACELP card, which can default to VSELP (ACELP/VSELP), or as a VSELP only card.

The number of simultaneous calls depends on whether each call uses TDMA-3 voice or AMPS data and on the MXC configuration. The ACELP configuration, with VSELP default, handles up to nine simultaneous calls per MXC. In this case, each MXC can support a up to three traffic-channel TRU-IIs and one control-channel TRU-II. The VSELP-only configuration supports up to 21 simultaneous calls and eight TRU-IIs.

For TDMA-3 voice calls, the MXC provides multiplexing/demultiplexing, vocoder, and loss/level functions. Each call (of any protocol type) uses one DS-30X timeslot to the IPE Backplane. This is nonblocking for TDMA-3, for

which a maximum of nine timeslots are required. The MXC uses one DS-30X timeslot for B-Channel HDLC signaling to the EIMC.

Microcellular Base Station (MBS) with radios

The MBS supports up to four radios. Each radio, a Transmit Receive Unit-II (TRU-II) for microcells, can operate independently as a control-channel radio or a traffic-channel radio (TDMA-3 voice, AMPS data). An internal 4 x 4 antenna matrix gives all four TRU-IIs simultaneous access to all four MBS antenna ports at the rear of the MBS.

Up to four MBSs can be co-located to provide support for up to 15 TRU-IIs on a common distributed antenna system.

The TRU-II software module does much of the protocol processing, equivalent to ISO layers 1, 2, and part of 3. The TRU-II communicates with the EIMC via the nailed-up TCM connection from the MXC.

The MBS requires local AC power (110/240VAC).

The MBS is 8.5 in.wide x 23 in. long and 21 in. high.

The total weight of an MBS is 85 lbs (including four TRU-IIs).

The loop length from the Meridian 1 to the MBS is limited to 3,000 ft. due to the TRU-II interface.

The MBS can be wall, floor, or rack mounted; the floor-mounted version can be secured for seismic compliance (see Figure 6 and Figure 7). For mounting restrictions, see Figure 35 and Figure 36.

Figure 6
MBS

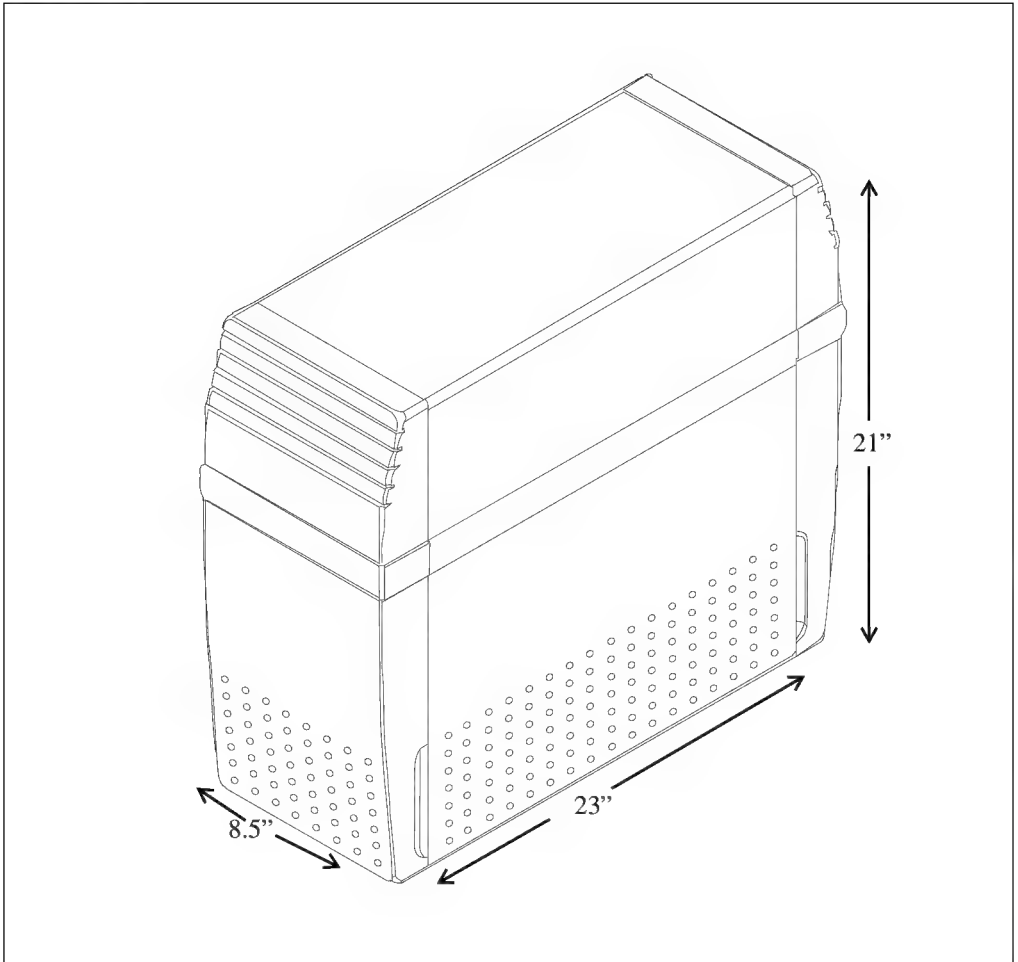
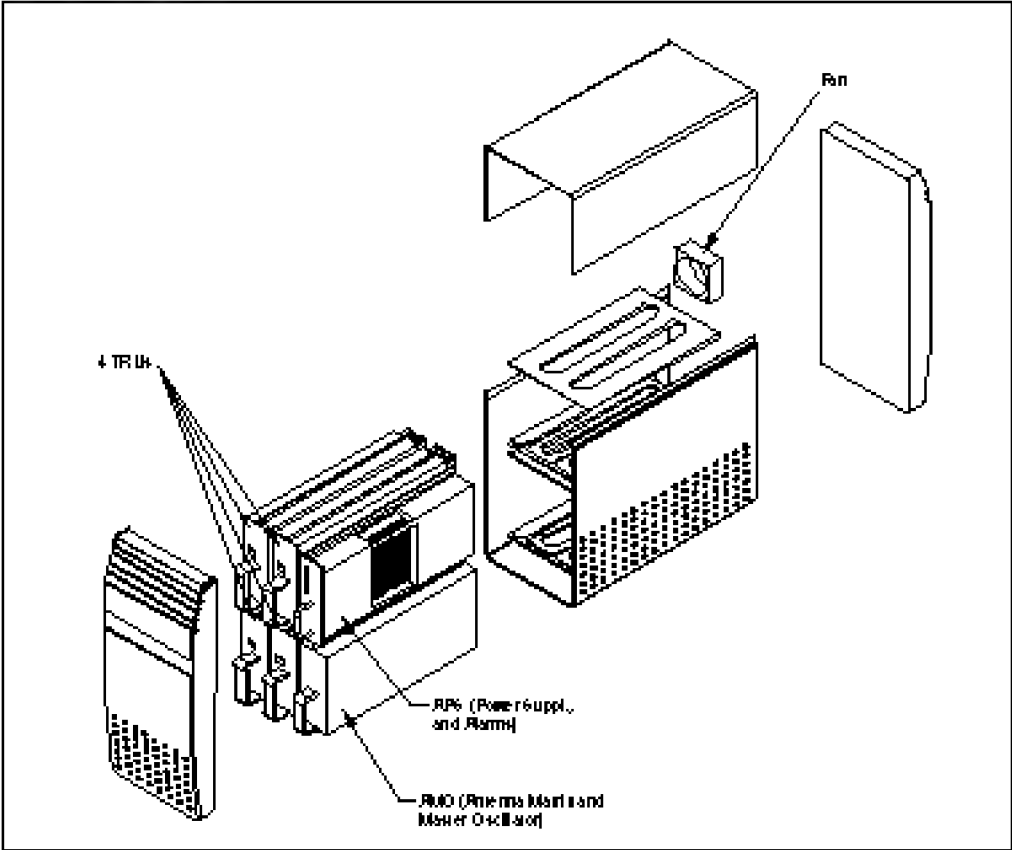


Figure 7
MBS-Exploded view



Distributed antenna system

A distributed antenna system provides air access to the Microcellular portables in a cell. Coaxial cables connect the MBS antenna ports to the antenna system. A cell can include up to 16 antennas with up to two hybrids (combiners/splitters). Table 1 shows typical combinations of TRU-IIs and antennas.

Table 1
TRU-II and antenna combinations

Configuration	TRU-IIs	Antennas	Purpose
4 X 1	4	1	Capacity
4 X 8	4	8	Coverage
8 X 4	8	4	Capacity
8 X 8	8	8	Coverage and capacity
16 X 16	16	16	Coverage and capacity

The area served by a single antenna system forms a *logical* cell, where a portable that registers in the cell can make or receive a call. The equipment that supports a single antenna system forms a *physical* cell. This includes all of the TRU-IIs in all of the MBSs that serve that cell.

The antenna array consists of directional and omnidirectional antennas connected via coaxial cable. If an application requires capabilities beyond these antennas, a Microcellular system can use other types of antennas.

Installation of a directional or omni antenna is on the ceiling, with a solid ceiling mount or a hidden ceiling mount. Figure 8 illustrates a directional antenna. Figure 9 illustrates an omni antenna.

Figure 8
Directional antenna (A0609534)

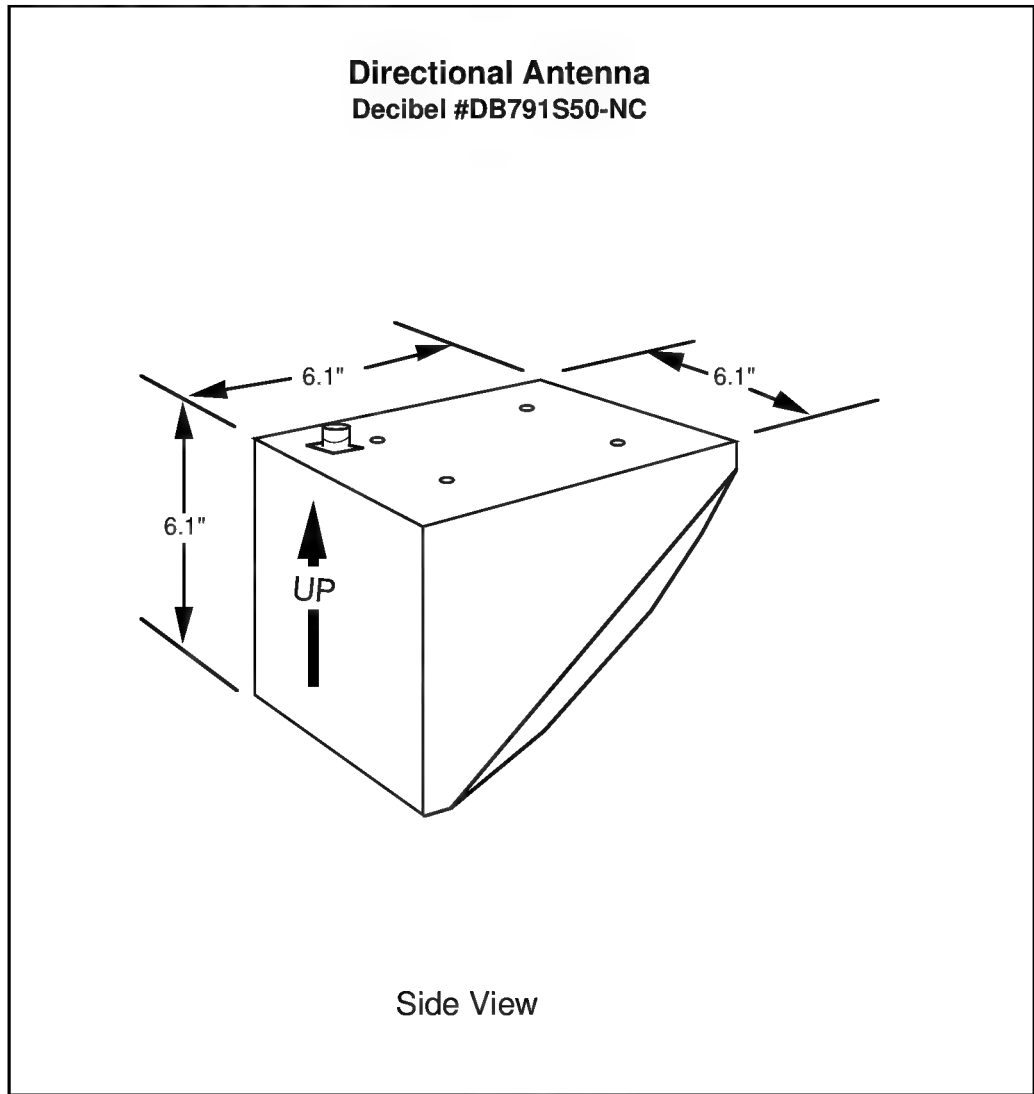
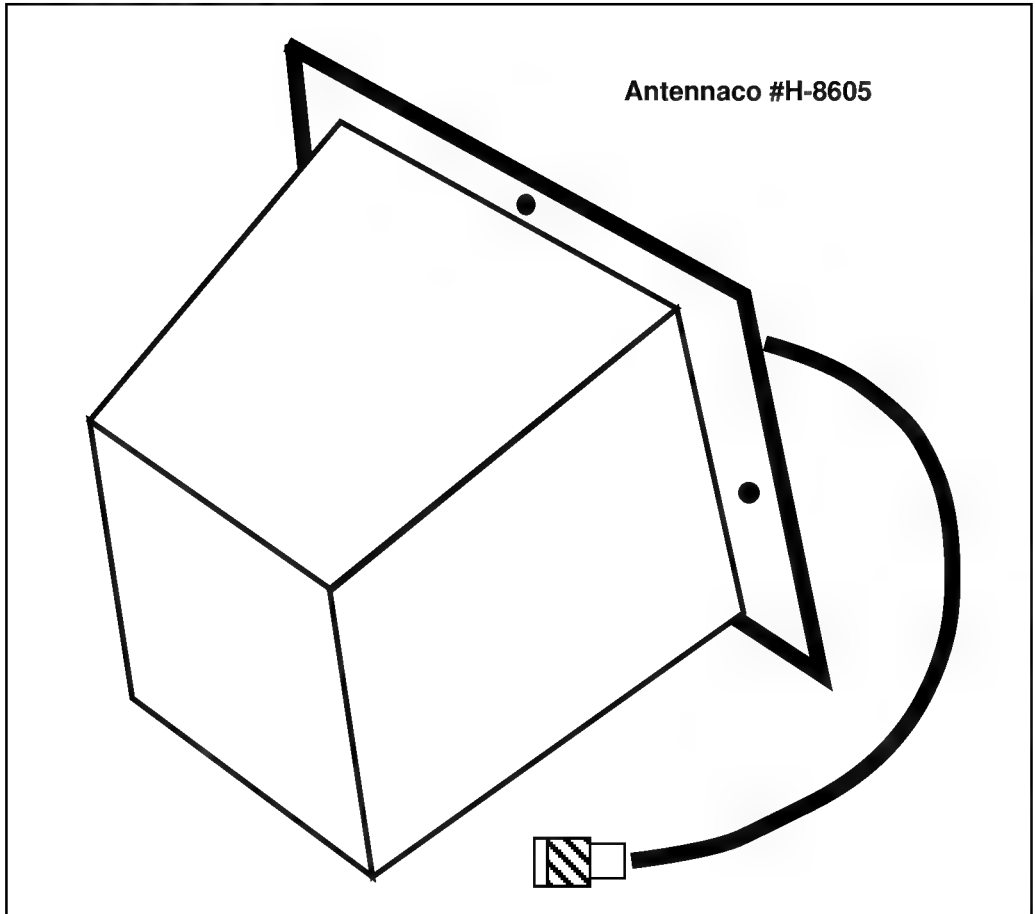


Figure 9
Omni antenna (A0659298)



Each MBS connects to the antenna array through four antenna ports. Every TRU-II in the MBS connects to all four ports at the same time through the 4 x 4 antenna matrix. External to the MBS, the four ports can connect to an array of up to 16 antennas through two Dual 8-Port Hybrids, or up to four MBSs can share the antenna array (allowing more TRU-IIs per cell).

Smaller Microcellular systems can use a Quad 4-Port Hybrids to connect two MBSs with up to eight antennas. The Quad 4-Port Hybrid also has lower signal loss, allowing longer cable lengths to the antennas.

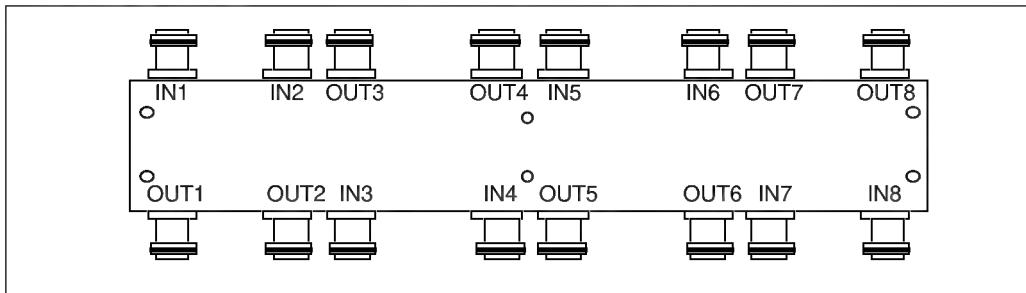
Hybrids

Hybrids (combiner/splitters) can connect the four MBS ports to up to 16 antennas. Hybrids must be near the MBSs because the cable between an MBS and a hybrid port is only 4.5 ft long. The antenna system for each cell can use one or two Dual 8-Port Hybrids or one Quad 4-Port Hybrid.

Dual 8-Port Hybrid

The Dual 8-Port Hybrid is about 14 in. long, with input and output ports on both sides. Figure 10 shows the hybrid ports.

Figure 10
Dual 8-Port Hybrid

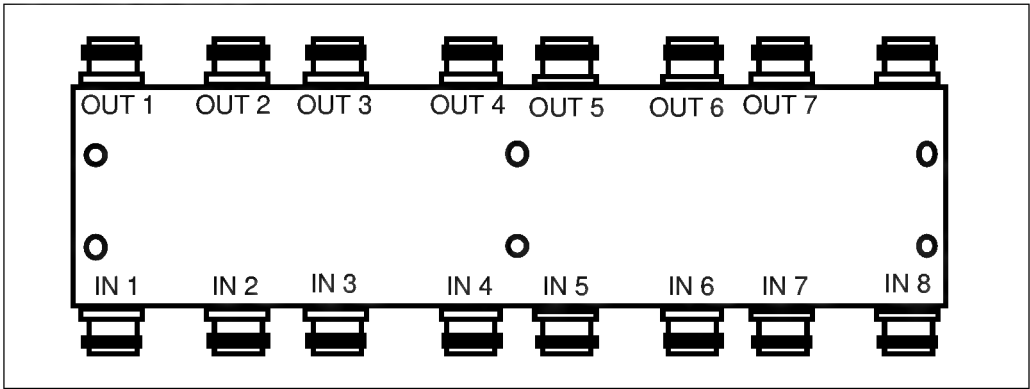


One or two Dual 8-port Hybrids can tie all the antennas in a cell together into a single antenna system, distributing the signal from every MBS to every antenna and from every antenna to every MBS. This distribution of signals provides receiver diversity.

Quad 4-Port Hybrid

The Quad 4-Port Hybrid is about 7 in. long, with input ports on one side and output ports on the other. Figure 11 shows the hybrid ports.

Figure 11
Quad 4-Port Hybrid



Automatic Frequency Planning Station (AFPS)

The AFP Station is a scanner-receiver that helps a cellular operator maintain the frequency plan of the microcell to prevent interference with the macrocellular system and to maintain signal quality for the Microcellular system. A Microcellular system requires at least 1 AFP Station.

An AFP Station can perform the following functions:

- Measure the forward and reverse Received Signal Strength Indicator (RSSI) on a specified channel or channels.
- Tune to each macrocell control channel and extract the SAT (Analog Supervisory Audio Tone), DVCC/DCC (Digital Verification Color Code/Digital Color Code), and SID (system identifier) values.
- Return the Bit Error Rate (BER) on a specified Microcellular control channel.

Each AFPS is connected to a DLC port on the Meridian 1 system through a TCM connection and emulates a phone set. Instead of TCM cabling, short-haul modems and telephone cable can provide a serial connection between an AFP Station and the local MSM MAT. The maximum length of TCM cable from an AFP Station to the Meridian 1 system is 3,000 ft. With a serial connection through short-haul modems, an AFP Station can be more than 3,000 ft from the Meridian 1 system.

The AFP Station is controlled by the MSM software running on a local MAT, which dials up an AFPS through a Meridian Communications Unit (MCU) or through the short-haul modems and queries the AFPS for data such as the RSSI and BER on specified channels. Part of Mobility System Management (MSM), the AFP software must run 24 hours a day on a local MAT that has access to the Meridian 1 system through an Ethernet interface.

Each AFP Station uses a local, plug-top power supply or, in some cases, a remote power supply. A Remote Power Interconnect (RPI) unit, either RPI8 or RPI16, can supply remote power for AFP Stations through a TCM connection.

Microcellular portables

A portable telephone in a Microcellular system is a wireless handset that conforms to the IS-136 (dual-mode ACELP or VSELP) or IS-54B CAI radio protocol. IS-136 has a digital or analog control channel. IS-54B is a subset of IS-136 and has only an analog control channel. Each portable device communicates with the Microcellular system via the air interface.

All industry standard portables that conform to the IS-136 or IS-54B standard will work with the Nortel COMPANION Microcellular system. Nortel has tested the Nokia 2160 portable for the IS-136 implementation or the Nokia 2120 portable for the IS-54B implementation.

The Nokia 2160 weighs 8.3 ounces with a slim NiMH battery. With this battery, the talk time is 70 minutes for a digital call or 45 minutes for an analog call, and the standby time is 14 hours. A larger NiMH battery extends the talk time to 210 minutes for a digital call or 120 minutes for an analog call and the standby time to 40 hours. This portable has a soft key interface.

Meridian Administration Tool (MAT)

The Meridian Administration Tool provides a platform for the Mobility System Management application and for Microcellular operations, administration, and maintenance (OA&M). A Release 23 Microcellular system requires MAT 5.7+ software.

At a Microcellular site, a local MAT connects to the Microcellular Meridian 1 system through Ethernet. A remote distributor MAT can also connect to the Meridian 1 system via dial-up modems (PPP) through a Public Switched Telephone Network (PSTN).

Nortel recommends an IBM PCTM or compatible for a local or remote MAT, with the following minimum configuration:

- Pentium 75 MHz CPU
- SVGA color monitor and interface card (800 x 600 resolution for graphics)
- Minimum of 500 MB of free space on hard drive (includes Windows 95TM requirements)
- 32 MB of RAM (upgradable)
- 3.5" floppy drive
- Two-button mouse
- 2 serial ports (at least one available if external modem is configured)
- Parallel port
- MS Windows 95 with TCP/IP
- Local connection to the Meridian 1 via Ethernet (required to run AFP software)
- Remote or local connection to the Meridian 1 via serial PPP Hayes compatible modem--internal or external (U.S. Robotics 28.8 preferred)
- Printer (optional)
- CD-ROM drive (optional, but recommended for the local MAT)

Cellco Mobility Control Point (CMCP)

The CMCP, an application that runs on the MAT 5 platform, enables a cellular company to control the use of voice channels and control channels by Microcellular systems within its licensed region. The CMCP application enables the cellular company to perform the radio frequency (RF) management of microcells.

Located at the cellular company site, the CMCP connects with the Meridian 1 system via a modem (PPP) connection through the Public Switched Telephone Network (PSTN).

For the CMCP connection, an Option 51C, 61C, 81, or 81C Meridian 1 system requires a serial port located on the network shelf of the system. This serial port provides 24-hour access to the CMCP. The serial ports on the core CPU are not acceptable for CMCP access.

Cellular service providers control private systems to minimize interference with their macrocellular services. The CMCP provides this control for the Microcellular system and performs the following tasks:

- Communicates with the Meridian 1 via the Point-to-Point Protocol (PPP) over a dedicated modem.
- Completes the configuration of Microcellular components
- Monitors and manages the radio frequency (RF) channels within a Microcellular system
- Initiates and monitors a “keep-alive” heartbeat between the CMCP and the Microcellular system
- Controls Automatic Frequency Planning (AFP) for the Microcellular system
- Specifies the maximum number of portables allowed and, optionally, secures the portable ESNs.

In addition to component configuration and channel allocation, the CMCP monitors Microcellular operation. If three consecutive heartbeat failures occur, the CMCP automatically shuts down and locks the Microcellular system.

Microcellular system capacity

Options 11C, 51C, 61C, 81, and 81C:

- Minimum of two TRU-IIs (radios) per MBS and cell (one TRU-II must be a control channel)
- Maximum of four TRU-IIs per MBS
- Maximum of four MBSs per cell
- One control-channel radio plus a maximum of three traffic-channel radios (TDMA-3 voice and AMPS data) per MXC for ACELP/VSELP
- One control-channel radio plus a maximum of seven traffic-channel radios (TDMA-3 voice and AMPS data) per MXC for VSELP only
- Minimum of one and maximum of 12 AFPS per Microcellular system

Options 51C, 61C, 81, and 81C:

- Maximum of 15 MXCs per IPE shelf for each EIMC. For a VSELP-only system, up to 12 MXCs per superloop may be configured.

Option 11C:

- Maximum of one EIMC
- Maximum of 15 Microcellular Transcoder Cards (MXCs) served by one EIMC

Although you can determine the maximum number of Microcellular users that a given system can support only after a review of the available memory, an Option 81 or 81C system can support up to 3,000 portable users, an Option 51C or 61C system can support up to 500 users, and an Option 11C system can support up to 200 users.

With 1% RF subsystem blocking for a 2-1/2 minute call, a single TDMA-3 voice channel can support up to 10 users in a single cell, two voice channels can support up to 46 users, and three voice channels can support up to 91 users. With 2% RF subsystem blocking, one channel can support up to 14 users, two channels can support up to 54 users, and three channels can support up to 104 users.

Multi-Site Networking

Multi-Site Networking is an optional feature of the Microcellular product that enables portable users who travel to networked locations to place and receive calls from their portables as if they were at their home system. It supports incoming call delivery to and outgoing call origination from a roaming portable at any Meridian 1 PBX that a portable user visits within a single private network.

When a portable roams to a visited system, the portable performs a location registration there. The visited system notifies the portable's home system, which updates its Home Location Register (HLR) with a "forwarding address" to which it can direct incoming calls for the portable.

A visited Meridian 1 PBX is on the same private network as the portable's home Meridian 1 system. Customer-defined ISDN links connect the Microcellular sites. Each Meridian 1 system in the Microcellular network has its own connection to the region's CMCP, which provides the cellular company with control over the Microcellular systems in its network. Each Meridian 1 system in the same Microcellular network uses the same dialing plan, either the Uniform Dialing Plan (UDP) or the Coordinated Dialing Plan (CDP), but not both.

For more information on Multi-Site Networking, see *Nortel COMPANION Microcellular Multi-Site Networking Description, operations, and administration* (553-3611-110).

Meridian 1 SL-1 or third-party PBX connectivity

You can place Microcellular components in a Meridian 1 system and then connect them to an existing Meridian 1 SL-1, SL-100, or Norstar switch or to a third-party PBX. This solution offers mobility services without upgrading or changing the existing PBX. The interconnection can be through private networking—for example, through a standard Integrated Services Digital Network (ISDN) PRA or Digital Trunk Interface, such as T1 or PRI.

Incoming calls to a portable can be achieved by giving Call Forward No Answer treatment to calls terminated on a wireline set. Outgoing calls from a portable across an ISDN PRA or DTI trunk require dialing Trunk Access Codes or codes defined for the Coordinated Dialing Plan. Twinning is not provided in this configuration.

With such a system arrangement, in addition to features available on the Microcellular Meridian 1, portables can have access to networking features provided by the host PBX. If the trunks to and from the Microcellular Meridian 1 are busy, portables receive existing intercept treatment. For a simple call involving a set connecting to the host PBX and another set to the Microcellular Meridian 1, CLID display might be possible, depending on the trunk type, as with any networking calls.

Preliminary design overview

A customer requests a preliminary design and quote by filling out the Microcellular Customer Information Form (Appendix A) with the sales representative, who returns the form to the Meridian 1 distributor.

For the IS-54B protocol, the sales representative or sales support engineer also takes preliminary Received Signal Strength Indicator (RSSI) readings at the customer site with a cellular phone and sends the RSSI readings to the distributor.

The distributor can prepare the preliminary design and quote or request these services from Nortel. To prepare a preliminary Microcellular design, the distributor needs the Indoor Microcellular Coverage Simulator (IMCS) software, which is part of the Nortel SY2003 Microcellular Planning and Deployment Tools.

Producing a preliminary design and quote

To produce the preliminary design and quote, the site planning engineer performs the following tasks:

- 1** Collect information for the design:
 - a** Customer Information Form
 - b** Preliminary RSSI readings from the customer site
 - c** Floor plans or sketches of the customer site
- 2** Run IMCS, a Windows 3.1 application, on a PC to design an antenna structure for the Microcellular system, using information from the Customer Information Form and the preliminary RSSI readings.

- 3 Combine the information from the IMCS simulation, the Customer Information Form, and information from Meridian Configurator to generate a preliminary equipment list that details the hardware required for the Microcellular site.
- 4 Prepare a preliminary design report and a quote based on the preliminary equipment list and site planning and installation costs.

In most cases, the hardware requirements generated during this preliminary design process are 85% to 90% accurate, if all the information provided is accurate.

Completing the Microcellular Customer Information Form

The sales representative or sales support engineer can help the customer fill out a copy of the Microcellular Customer Information Form (Appendix A) and return the form to the Meridian 1 distributor. The site planning engineer uses information from the questionnaire to prepare the preliminary design and quote for the customer, including a Microcellular equipment list.

This form requests information about the customer's Meridian 1 distributor, existing cellular service, existing Meridian 1 systems, and the buildings at the proposed Microcellular site.

RSSI Readings

To prepare the preliminary design, you need to take Received Signal Strength Indicator (RSSI) readings from the macrocellular system around the perimeter of the Microcellular site for AFPS deployment and throughout the site for IS-54B service.

For AFPS deployment, you need to patrol the interior perimeter of the highest point of the building and make note of where the external macrocellular signal is the strongest. When recording the readings, consider the following guidelines for AFPS deployment:

- Place AFP Stations at the highest points of the Microcellular site, but not higher than the 10th floor. For example, for a four-story building, place the AFP Stations in the ceiling of the 4th floor.
- Each AFPS can cover approximately 100,000 square feet of floor space, based on the perimeter of one story of the building.
- Place multiple AFP Stations as far from each other as possible.
- Do not place an AFPS within 30 feet of a Microcellular antenna.

For a Microcellular system to provide IS-54B service, the Microcellular service has to be the best server in the service area. The Microcellular control channel levels must be greater than the existing macrocellular control channel levels by 3dB to 5dB. Without knowledge of these macrocellular signal levels, it is difficult to complete a Microcellular design.

This section describes how to use a Nokia 2160 or 2120 portable telephone to measure the macrocellular interference levels. The measurements that the

Nokia portable provides are not calibrated. The macrocellular operator might know the exact levels.

WARNING

Any deviation from the following procedure can affect your macrocellular service. Also, changing certain settings on your portable can make it inoperable on the macrocellular system.

Recording measurements

To record RSSI measurements, you need a copy of up-to-date floor plans for the Microcellular site and a portable telephone or other RSSI receiver. For each measurement, record both the channel number and signal strength on the floor plans at the location in the building where you take the measurement. Take at least five measurements at each location to ensure accurate readings.

If floor plans are not available, use a sketch of the building.

Placing the portable in test mode

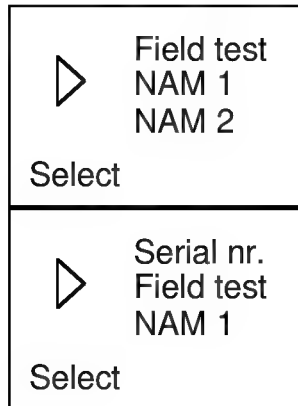
The first step in the measuring process is to put the portable into test mode. In test mode the portable can display the channel that it is on along with the signal strength of that channel.

To place a Nokia 2160 or 2120 portable in test mode, perform the following procedure:

- 1** Turn on the portable.
- 2** Enter the access code: *3 0 0 1 # 1 2 3 4 5
- 3** Press the [Menu] softkey.

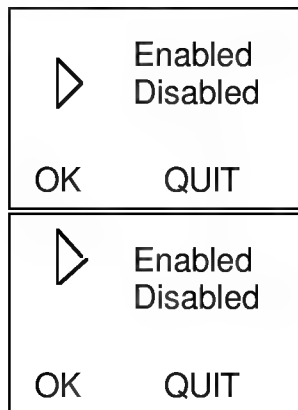
The portable displays its programming menu, as Figure 12 shows. Press the up arrow key to position the marker on Field test.

Figure 12
Nokia portable programming menu



- 4 With the marker on Field test, press the [Select] softkey. The display changes to look like Figure 13.

Figure 13
Nokia Field test menu



- 5 Use the up arrow key to position the marker on Enabled. Then, press the [OK] softkey to enable the test mode.

The portable displays the programming menu again.

- 6 Turn off the portable to get out of programming mode.

When you turn on the portable again, it will be in test mode.

Taking RSSI readings

- 1 After placing the Nokia portable in test mode, hold the portable where you want to take an RSSI measurement and turn the portable back on.

The portable displays test mode data, as Figure 14 shows.

Figure 14
Nokia portable test mode display

		1
-rrr	0	3
cccc	-	0
IDLE		
Menu		Memory

rrr is the received signal strength indicator (RSSI), in dBm.

cccc is the channel that the phone has locked onto (strongest control channel).

Record the RSSI measurement for that location on the floor plans.

- 2 For each measurement, hold the portable where you want to measure, turn the phone off and back on, and record the measurement.
- 3 To take the phone out of test mode, follow the procedure under “Placing the portable in test mode” on page 38 but place the marker on Disabled. Then turn the portable off and back on.

Choosing measurement locations

Take readings throughout the building because macrocellular signal levels can vary at different points in the building. Nortel recommends taking measurements at the building corners and center. Irregular buildings might require more measurements to get accurate interference levels.

IMCS antenna simulation

The Indoor Microcellular Coverage Simulator (IMCS) analyzes indoor radio frequency (RF) coverage for indoor microcell deployment. Engineers can use this simulator to evaluate the design of Microcellular system deployment before the actual installation of antennas. The basis for a Microcellular system is a simulcasting antenna system.

This simulation calculates the Receiver Signal Strength Indicator (RSSI) level, in dBm, of the entire area that the Microcellular system covers. The simulation considers path loss, multipath fading, and shadowing factors. It can predict coverage probability given a certain RSSI threshold level. For acceptable RF coverage, the RSSI levels must be higher than or equal to an RSSI level that you specify for the simulator.

IMCS displays the results of RSSI estimates for a Microcellular system in a graphical color plot.

The simulation runs under MS Windows 3.1.

Note: An IMCS simulation does not directly take into account interior walls or obstructions and is limited to rectangle-style buildings. For a large obstruction, such as an interior elevator shaft, marble pillar, or metal wall, treat the obstruction as an outside wall and the coverage area as separate buildings. If an obstruction would probably not allow RF propagation, the area behind the obstruction is a potential dead area.

Preparing to run a simulation

The specific configuration of a site controls the IMCS simulation. To perform a precise analysis for a Microcellular system, you need the following information:

- Building specifications for the Microcellular coverage area, from the Customer Information Form or from floor plans
 - Building type (office, factory, or other)
 - Building dimensions (length and width)
 - Number of floors
- Antenna and cable information, from the Customer Information Form and from antenna and cable documentation
 - Possible antenna locations
 - Number and type of antennas

Start with an estimate of the number of antennas, such as 4 antennas for a single-floor rectangular building. You can change the number of antennas and rerun IMCS until you get acceptable simulation results.

The Microcellular system currently supports two antenna types, omnidirectional DB 781 (omni) and directional DB 791.
 - For directional antennas, the pointing direction of each antenna
 - Estimated cable length associated with each antenna
 - Hybrid loss associated with each antenna: 3 dB for the Quad 4-Port Hybrid or 7 dB for the Dual 8-Port Hybrid
 - Cable type

IMCS support four cable types. For a Microcellular system, you can use 1/4 in., 3/8 in., or 1/2 in. cable. Nortel recommends the 1/2 in. size to minimize signal loss, which is inversely proportional to the cable radius.
- If the site will use the IS-54B protocol, on-site RSSI measurements

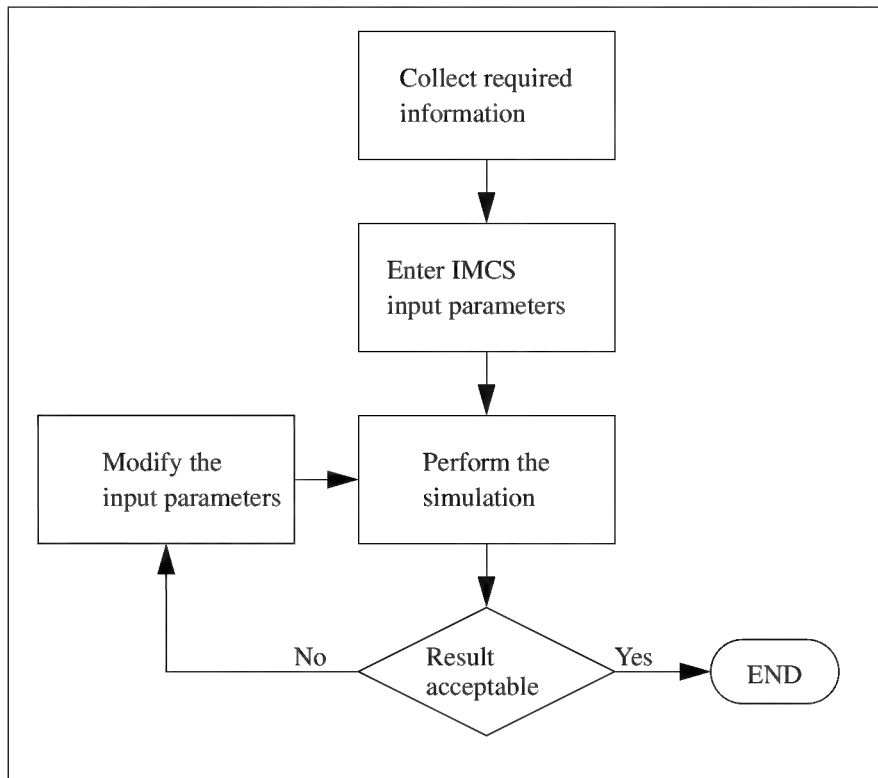
The IMCS output contains the following information:

- The percentage of the coverage area that meets a certain RSSI level
- An estimate of the mean RSSI level for every grid in the building, which IMCS displays in a color plot

Running an IMCS simulation

Indoor RF deployment is a trial-and-error process. Figure 15 shows a flow chart of the simulated iteration process.

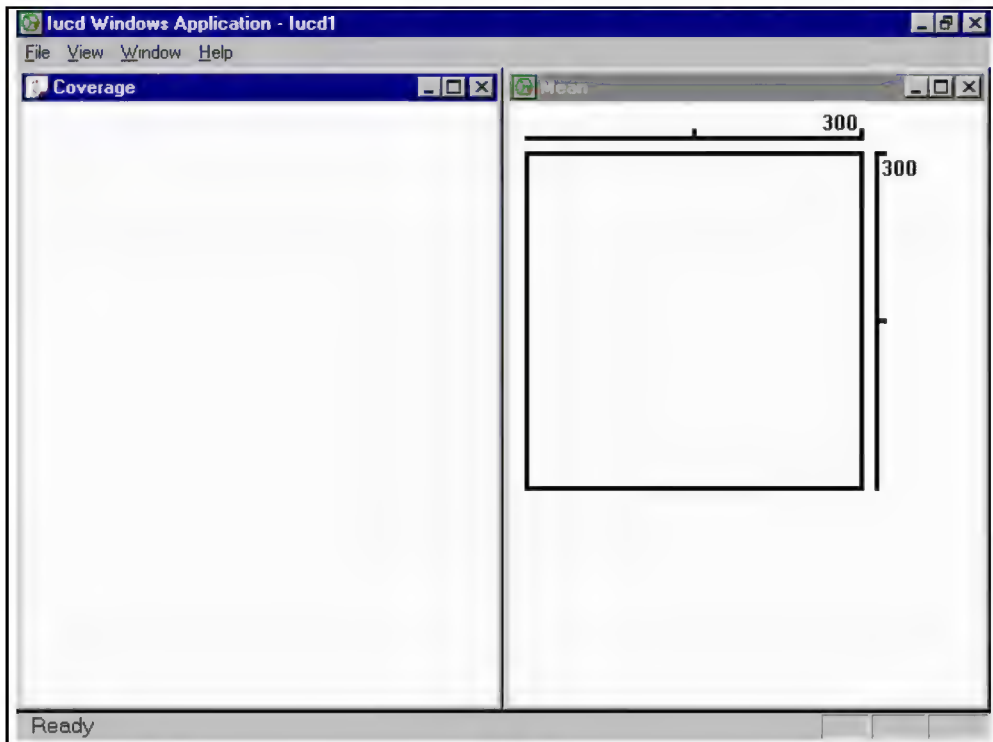
Figure 15
Process flow chart



To begin the design an antenna structure for a Microcellular system, perform the following procedure:

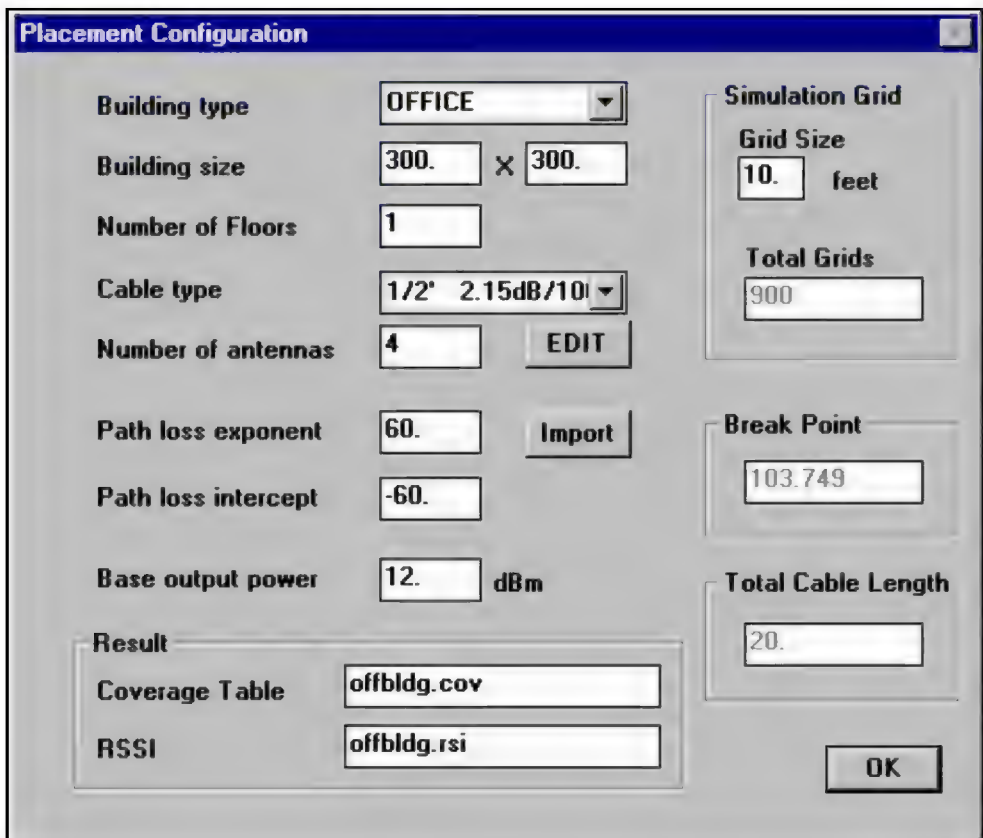
- 1 Start running the IMCS software on a PC.
- 2 Choose **New** from the **File** menu. The Coverage window appears, as Figure 16 shows.

Figure 16
IMCS Coverage window



- 3 Choose **Configuration** from the **File** menu. The **Placement Configuration** window appears, as Figure 17 shows.

Figure 17
IMCS Placement Configuration window



The image shows a software window titled "Placement Configuration". It contains several input fields and buttons for configuring a simulation. The fields are organized into two main columns. The left column contains: "Building type" (a dropdown menu set to "OFFICE"), "Building size" (two text boxes with "300." and "300." separated by a multiplication sign), "Number of Floors" (a text box with "1"), "Cable type" (a dropdown menu set to "1/2' 2.15dB/10'"), "Number of antennas" (a text box with "4" and an "EDIT" button), "Path loss exponent" (a text box with "60." and an "Import" button), "Path loss intercept" (a text box with "-60."), "Base output power" (a text box with "12." followed by "dBm"), and a "Result" section with "Coverage Table" (text box with "offbldg.cov") and "RSSI" (text box with "offbldg.rsi"). The right column contains: "Simulation Grid" with "Grid Size" (text box with "10." followed by "feet") and "Total Grids" (text box with "900"); "Break Point" (text box with "103.749"); and "Total Cable Length" (text box with "20."). An "OK" button is located at the bottom right.

Parameter	Value
Building type	OFFICE
Building size	300. x 300.
Number of Floors	1
Cable type	1/2' 2.15dB/10'
Number of antennas	4
Path loss exponent	60.
Path loss intercept	-60.
Base output power	12. dBm
Simulation Grid Grid Size	10. feet
Simulation Grid Total Grids	900
Break Point	103.749
Total Cable Length	20.
Coverage Table	offbldg.cov
RSSI	offbldg.rsi

- 4 Enter the parameters for the IMCS simulation, as “Input parameters” on page 49 describes.
- 5 Enter the details for each antenna, as “Antenna information” on page 51 describes.
- 6 Click **OK** without changing the **Base output power** value, which defaults to 12 dBm. The Coverage window reappears.
- 7 Choose **Save** from the **File** menu and enter a file name for your antenna configuration.
- 8 Run the simulation, as “Simulation execution” on page 54 describes.
- 9 Examine the results, which “Simulation results” on page 54 describes.
- 10 If the results are not acceptable, modify the input parameters or antenna details and repeat the simulation.

Adjust the values you entered and repeat the rest of the procedure until 95% of the coverage area has a signal strength of -85dBm or stronger.

For the IS-54B protocol, if you have RSSI readings from the site, use a minimum coverage value that is 3dBm to 5dBm stronger than the interference level. For example, if the salesperson reports an interference level of -65dBm, run the simulation with a coverage goal of -62dBm to -60dBm.

You can print the graphic of the antennas and signal levels for the preliminary design report. You can also print the IMCS reports.

Input parameters

The IMCS input parameters control the simulation. You need to enter all the parameter information correctly to get valid results. To enter this data, choose **Configuration** from the **File** menu. Figure 17 shows an example of the basic simulation input parameters.

Building information

The parameters **Building size** and **Number of Floors** define the coverage area. IMCS requires this information, which you can obtain from the Customer Information Form, the building floor plans, or the customer contact person.

Cable type

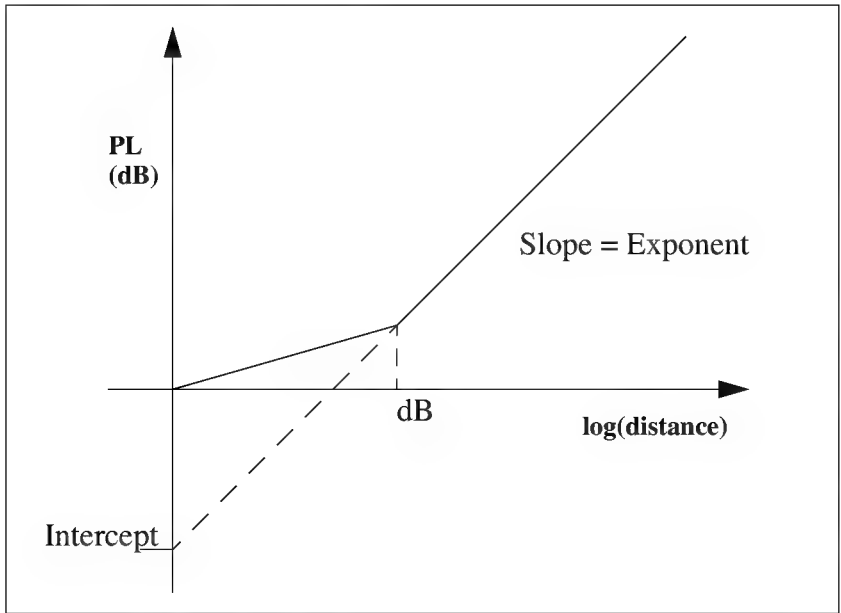
For each simulation, you can specify only one type of cable for use throughout the building. Four cable types are available, each associated with a different percentage of signal loss. For minimum signal loss, Nortel recommends 1/2 in. cable.

RF characteristic information

The parameters **Path loss exponent** and **Path loss intercept** represent the specific RF propagation model of this building. For the IS-136 protocol, you can use 60 for **Path loss exponent** and -60 for **Path loss intercept** (or 40 and -40 for an antenna in a protected outside area, such as a covered patio).

For a propagation model, IMCS uses a two-segment piecewise linear model. This model consists of two segments and one breakpoint, which Figure 18 illustrates. IMCS always assumes that the first segment has a free-space propagation loss with a slope of 20. The **Path loss exponent** and **Path loss intercept** values actually represent the second segment.

Figure 18
Two-segment piecewise linear model



In this model, dB is the breakpoint. The dB value usually ranges from 10 to 20 meters for an indoor environment.

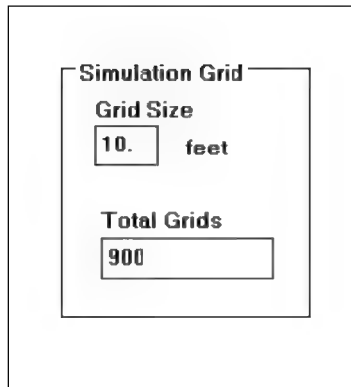
Result Storage

In addition to the simulation parameters, IMCS needs the names of two files for storing the simulation results. Specify one result file for **Coverage Table** and another for **RSSI** in the **Result** box, which Figure 17 shows.

Simulation Grid

Another input parameter is the grid size, which Figure 19 shows. When you enter the simulation grid size, IMCS updates the total grid number. The smaller the grid size, the higher the simulation resolution. Grid size also affects the simulation time because a reduction in grid size increases the total number of grids, which increases the time that IMCS requires to run the simulation.

Figure 19
Grid size input



The image shows a screenshot of a software dialog box titled "Simulation Grid". Inside the dialog box, there are two input fields. The first field is labeled "Grid Size" and contains the value "10." followed by the unit "feet". The second field is labeled "Total Grids" and contains the value "900".

Antenna information

After you enter the basic input parameters, you need to provide details about each antenna. The antenna information includes location, antenna type, pointing direction, and the associated cable type, length, and hybrid loss.

To pop up the Antenna Information dialog box, click the **EDIT** button (Figure 17). Figure 20 shows the dialog box.

You can start with one directional antenna at each corner and work inward. The antennas should face inward to avoid interfering with the macrocellular system. You might need only two antennas at opposite corners.

Antenna type

Two types of antennas are available, the omni antenna, DB 781, and the directional antenna, DB 791. IMCS has an antenna radiation pattern for each antenna type.

Figure 20
Antenna information

Antenna #	1
Antenna Type	DB791.ANT 
Floor	1
Location X	30.
Location Y	50.
Direction	0.
Cable Length	100.
Hybrid loss	7.1

Antenna position and orientation

The **Floor**, **Location X**, and **Location Y** values define the antenna location:

- Enter an integer greater than zero for the floor number.
- Specify an antenna location on the X axis and on the Y axis in feet.

For a directional antenna, **Direction** specifies the antenna pointing direction in degrees. Figure 21 shows the direction orientation reference. Figure 22 shows a placement example for a directional antenna.

Figure 21
Antenna main-beam direction reference

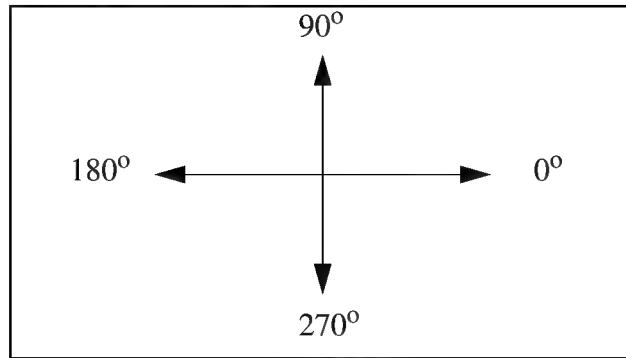
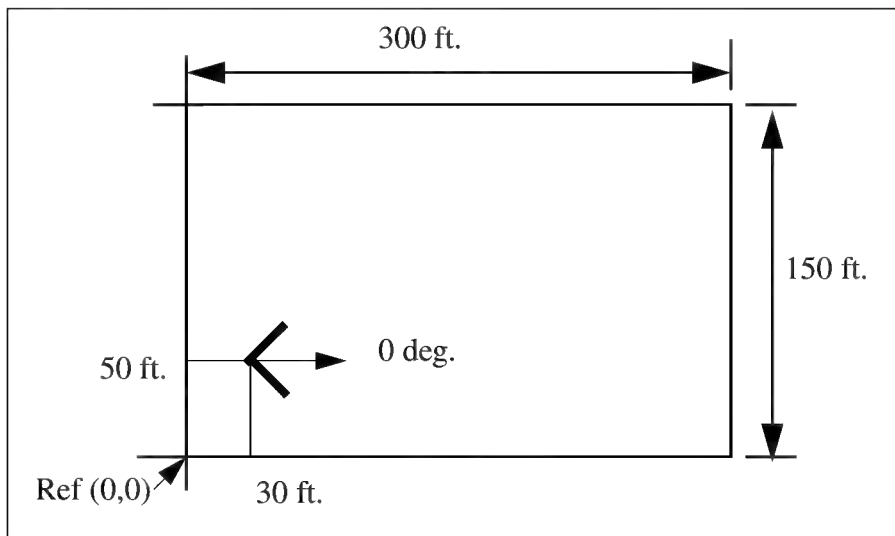


Figure 22
Placement example for directional antenna



Antenna connections

The loss of signal strength from antenna connections and cable runs also affect the simulation results. The actual loss depends on how you engineer the system, so you need to estimate **Cable Length** and **Hybrid loss** values from a possible Microcellular configuration for the coverage area.

Specify the amount of coaxial cable, in feet, to connect the antenna to the hybrid.

For your distance estimates, use straight lines between pieces of equipment unless you have additional routing information, such as whether the cable is to run through a plenum or conduit. (A plenum is an enclosed space to which air ducts are connected within a building's air distribution system.) Shorter cable runs are easier to install. The maximum cable length for each size of cable depends on the signal-loss characteristic (attenuation) of the type of cable.

If the antenna is to connect to the MBS through a hybrid, specify the average hybrid signal loss (7 dB for a Dual 8-Port Hybrid, 3dB for a Quad 4-Port Hybrid).

Simulation execution

After you enter all the required data, choose **Save** from the **File** menu and specify a file for the configuration, and then choose **Run** from the **File** menu to perform the simulation. IMCS indicates the progress of the simulation in a progress bar that appears during the simulation.

Simulation results

When the simulation completes, IMCS displays Estimated RSSI and Coverage results.

Estimated RSSI

IMCS displays the estimated RSSI coverage as a color plot. Each color represents a possible range of RSSI values. Figure 23 and Figure 24 show the color table and an example of the estimated RSSI value for every spot.

Figure 23
IMCS color table

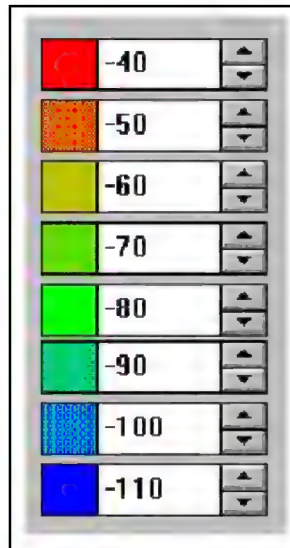
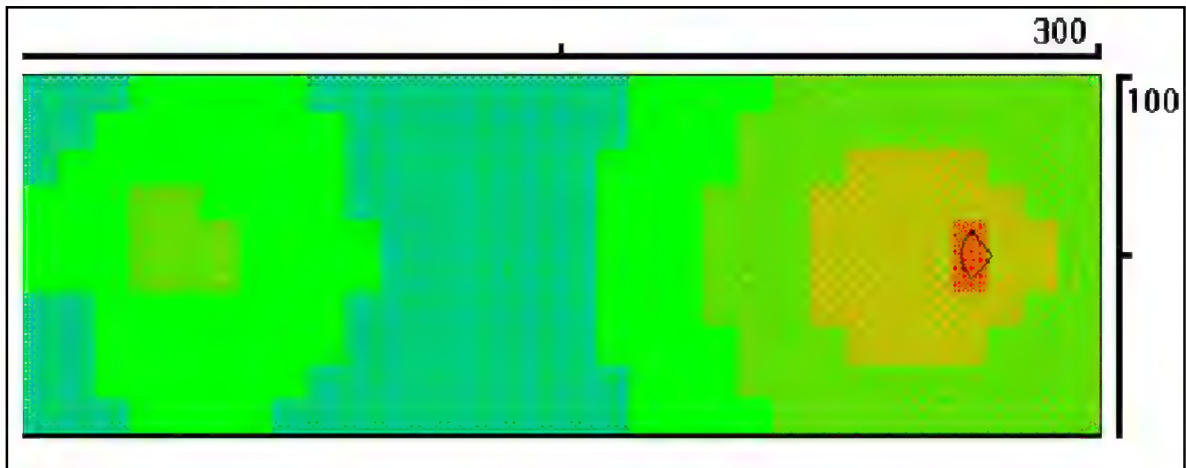


Figure 24
Color plot of estimated RSSI



Coverage result

The Coverage result is actually is cumulative density function that IMCS displays as a table. Table 2 shows a portion of a coverage table.

Table 2
Coverage

Percentage	dBm
91.23 %	-91.5
92.56 %	-93.5
93.64 %	-94.5
94.57 %	-95.5
<u>95.38 %</u>	-96.5
96.15 %	-97.5
96.77 %	-98.5
97.46 %	-99.5

This table also indicates that about 95% of the covered area has a signal strength higher than or equal to -96.5 dBm.

Examining IMCS results

IMCS provides a simulation vehicle to help you visualize the RF signal coverage based on a specific deployment design. You decide whether the results are acceptable or you need another simulation iteration.

You can make this decision, based on the simulation result, in two ways:

- 1** Check the RSSI level for 95% of the coverage area. This value should be greater than -85dBm for an IS-136 cell or 3dB to 5dB stronger than the strongest interfering control channel for an IS-54B cell, and at least 17 dB higher than the co-channel signal strength for IS-136 or IS-54B.
- 2** Examine the color plot with the floor plans for the cold spots.

If the result is not acceptable, try moving or adding antennas.

Preliminary design and equipment list

You can combine information from the IMCS simulation, the RSSI readings, and the Customer Information Form to prepare a preliminary design and equipment list for a Microcellular system at the customer site. The IMCS simulation provides an initial number of antennas for the Microcellular system. To configure a Microcellular system and to estimate its hardware and software requirements, take the following steps:

- 1** Estimate the number of cells from the number of antennas that the IMCS simulation estimates.
- 2** Perform traffic calculations for each cell, using data from the Customer Information Form, to determine the number of TRU-IIs that the cell needs. Traffic calculations can also show where you need to split cells and what kind of hybrid to use for a cell.
- 3** Using the results of these calculations, configure the antenna array for each cell.
- 4** From the antenna arrays, determine the number and types of hybrids and hybrid connectors, the amount of coaxial cable, and the number of cable connectors.
- 5** From the traffic calculations and antenna configurations, determine the total number of TRU-IIs.
- 6** From the number of TRU-IIs, determine the number of MBSs.
- 7** Determine the number of AFP Stations for the site, roughly one for every 100,000 square feet of floor space (based on the perimeter of one story of the building).
- 8** Determine the number of Microcellular cards you need for the Meridian 1 system.

- 9** Determine whether the Meridian 1 system has the prerequisites required for the Microcellular system.
- 10** Prepare a preliminary equipment list that includes the following parts:
 - a** Nortel system package of Microcellular hardware and software
 - b** Any prerequisite hardware and software that the Meridian 1 system needs to support the Microcellular system. (If the site does not have a Meridian 1 system, include it as a prerequisite.)
 - c** Additional Microcellular parts for extra Meridian 1 cards, documents, Field Replaceable Components, planning and deployment tools, and spares
 - d** Coaxial cable and connectors provided by other manufacturers
 - e** TCM cable between the Meridian 1 system and each MBS
 - f** For each MBS, a wooden backboard, frame punch-down blocks, and a permanent ground wire
 - g** To connect AFP Stations to a Release 23 Meridian 1 system using TCM connections, the following equipment:
 - TCM cable to connect each AFP Station to a port on a Digital Line Card (DLC)
 - TCM cable to connect the MCU to the Meridian 1 system (TCM cable length between the Meridian 1 system and an AFP Station or the MCU cannot exceed 3,000 ft.)
 - Either the local power supply that comes with each AFP Station or a Remote Power Interconnect (RPI) unit (RPI8 or RPI16) with TCM cable to connect the RPI to the AFP Stations

- h** To connect AFP Stations to a Release 23 Meridian 1 system using serial connections, the following equipment:
 - Two short-haul modems for each AFP Station (for example, SRM-5A or SRM-5D miniature asynchronized short-range modem from RAD Data Communications, Ltd.)
 - Two RS-232 modem pool cables (one for each modem)
 - Telephone cable to connect each AFP Station to the local MSM MAT (cable length between the modems can be longer than 3,000 ft.)
 - Either the local power supply that comes with each AFP Station or a Remote Power Interconnect (RPI) unit (RPI8 or RPI16) with TCM cable to connect the RPI to the AFP Stations
- i** Uninterrupted Power Supply (UPS) for battery backup during power loss for MBSs, AFP Stations, and the MCU
- j** If AC power surge is a known issue, supplemental external power surge protectors for the MBSs, AFP Stations, and the MCU

A cell is a physical area of coverage that has a minimum of one MBS and a maximum of four MBSs. This is equivalent to a partition.

The following limits and characteristics also apply to a cell:

- 1 to 16 antennas
- 15 TRU-IIs maximum
- Directional or omnidirectional antennas
- No hybrid, one Quad 4-Port Hybrid, or one or two Dual 8-Port Hybrids

To estimate the number of cells in a Microcellular system, start with the number of antennas from the IMCS simulation and perform traffic calculations to determine the number of TRU-IIs necessary to support the user population.

Traffic calculations

Traffic calculations estimate the number of TRU-IIs per cell based on the number of users per cell. These calculations can also help you determine whether to split any cells and what kind of hybrid to use for a cell. The traffic calculations use the Erlang B table. Table 3 lists Erlang B values that are relevant to Microcellular engineering.

For TDMA voice, perform the traffic calculation as follows:

- 1 Use 2% blocking.
- 2 From the total user population specified on the customer questionnaire, estimate the number of users per cell.
- 3 Calculate the number of Erlangs:
 $(\# \text{ of Users}) * (2.5 \text{ minutes per call}) * (0.0166 \text{ hours per minute}) = \text{Erlangs}$
- 4 In the 2% column of the Erlang B table, locate the row in which the Erlang value that is just greater than the Erlang value you calculated.
- 5 Read the number of simultaneous TDMA-3 calls in that row (Number of calls column), divide the number by 3, and round up to get the number of TRU-IIs.
- 6 If the number of TRU-IIs is greater than 15, you need to split the cell.
- 7 If the number of TRU-IIs is greater than 8 when you use the Quad 4-Port hybrid, then use the Dual 8-Port hybrid.

For AMPS data, perform the traffic calculation as follows:

- 1 Use 2% blocking.
- 2 From the total user population specified on the customer questionnaire, estimate the number of users per cell.
- 3 Calculate the number of Erlangs:
 $(\# \text{ of Users}) * (10 \text{ minutes per call}) * (0.0166 \text{ hours per minute}) = \text{Erlangs}$
- 4 In the 2% column of the Erlang B table, locate the row in which the Erlang value that is just greater than the Erlang value you calculated.
- 5 Read the number of simultaneous AMPS calls in that row (Number of calls column). The number of AMPS calls = the number of TRU-IIs.

- 6 If the number of TRU-IIs is greater than 15, you need to split the cell.
- 7 If the number of TRU-IIs is greater than 8 when you use the Quad 4-Port hybrid, then use the Dual 8-Port hybrid.

Table 3
Erlang B model—blocked calls cleared

Number of calls	Blocking probability					
	1.0%	1.2%	1.5%	2%	3%	5%
1	0.0101	0.0121	0.0152	0.0204	0.0309	0.0526
2	0.153	0.168	0.190	0.223	0.282	0.381
3	0.455	0.489	0.536	0.602	0.715	0.899
4	0.869	0.922	0.992	1.09	1.26	1.52
5	1.36	1.43	1.52	1.66	1.88	2.22
6	1.91	2.00	2.11	2.28	2.54	2.96
7	2.50	2.60	2.74	2.94	3.25	3.74
8	3.13	3.25	3.40	3.63	3.99	4.54
9	3.78	3.92	4.09	4.34	4.75	5.37
10	4.36	4.61	4.81	5.08	5.53	6.22
11	5.16	5.32	5.64	5.84	6.33	7.06
12	5.88	6.05	6.29	6.61	7.14	7.95
13	6.61	6.80	7.05	7.40	7.97	8.83
14	7.35	7.56	7.82	8.20	8.80	9.73
15	8.11	8.33	8.61	9.01	9.65	10.6
16	8.88	9.11	9.41	9.83	10.5	11.5
17	9.65	9.89	10.2	10.7	11.4	12.5
18	10.4	10.7	11.0	11.5	12.2	13.4

Number of calls	Blocking probability					
	1.0%	1.2%	1.5%	2%	3%	5%
19	11.2	11.5	11.8	12.3	13.1	14.3
20	12.0	12.3	12.7	13.2	14.0	15.2
21	12.6	13.1	13.5	14.0	14.9	16.2
22	13.7	14.0	14.3	14.9	15.8	17.1
23	14.5	14.8	15.2	15.8	16.7	18.1
24	15.3	15.6	16.0	16.6	17.6	19.0
25	16.1	16.5	16.9	17.5	18.5	20.0
26	17.0	17.3	17.8	18.4	19.4	20.9
27	17.8	18.2	18.6	19.3	20.3	21.9
28	18.6	19.0	19.5	20.2	21.2	22.9
29	19.5	19.9	20.4	21.0	22.1	23.8
30	20.3	20.7	21.2	21.9	22.1	24.8
31	21.2	21.6	22.1	22.8	24.0	25.8
32	22.0	22.5	23.0	23.7	24.9	26.7
33	22.9	23.3	23.9	24.6	25.6	27.7
34	23.8	24.2	24.8	25.5	26.8	28.7
35	24.6	25.1	25.6	26.4	27.7	29.7
36	25.5	26.0	26.5	27.3	28.6	30.7
37	26.4	26.8	27.4	28.3	29.6	31.6
38	27.3	27.7	28.3	29.2	30.5	32.6
39	28.1	28.6	29.2	30.1	31.5	33.6
40	29.0	29.5	30.1	31.0	32.4	34.6

Number of calls	Blocking probability					
	1.0%	1.2%	1.5%	2%	3%	5%
41	29.9	30.4	31.0	31.9	33.4	35.6
42	30.8	31.3	31.9	32.8	34.3	36.6
43	31.7	32.2	32.8	33.6	35.3	37.6
44	32.5	33.1	33.7	34.7	36.2	38.6
45	33.4	34.0	34.6	35.6	37.2	39.6
46	34.3	34.9	35.6	36.5	38.1	40.5
47	35.2	35.8	36.5	37.5	39.1	41.5
48	36.1	36.7	37.4	38.4	40.0	42.5
49	37.0	37.6	38.3	39.3	41.0	43.5
50	37.9	38.5	39.2	40.3	41.9	44.5

Antenna arrays

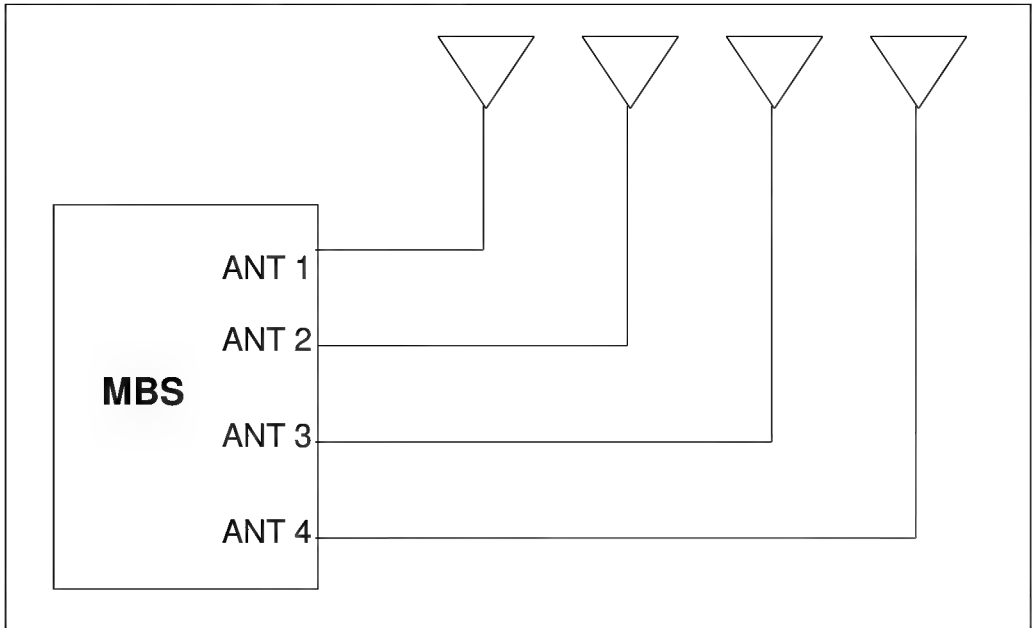
The IMCS simulation generates output that contains the antenna location and coaxial cable length (straight-line only). Use this information and the results of the traffic calculations to estimate the number of antennas, the type and number of hybrids required, and the total amount of coaxial cable (in straight lines).

If a cell has more than 16 antennas, then you need to split the cell and run the IMCS simulation again.

Antenna array with no hybrid

A Microcellular system with one to four antennas does not need a hybrid, as Figure 25 illustrates. This configuration does, however, require RF cables and female-to-female end-type connectors.

Figure 25
Configuration for one to four antennas

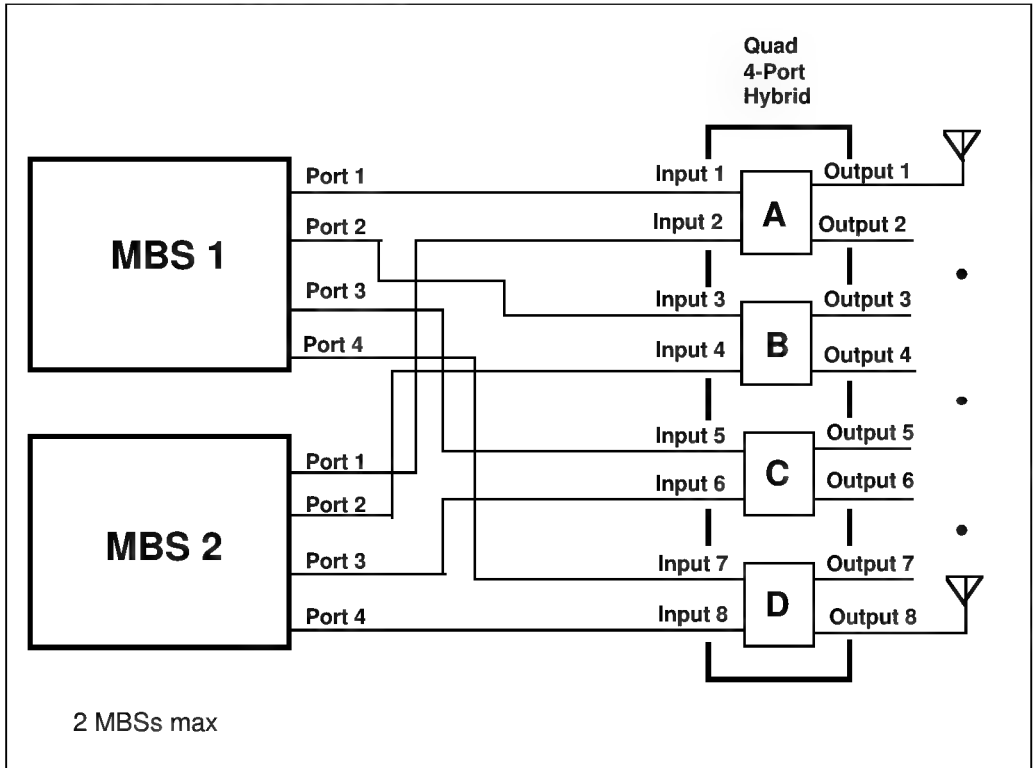


For more than four antennas, the Microcellular antenna system uses one or two hybrids to connect the MBS to the antennas. Each Dual 8-Port Hybrid includes two separate 8-port networks. Each Quad 4-Port Hybrid includes four 4-port networks (two input ports and two output ports each).

Antenna array with one hybrid

The one-hybrid configuration is for cells with up to 8 antennas, as Figure 26 illustrates. The installer must mount the hybrid near the MBSs. For this configuration, you can use either a Quad 4-Port Hybrid or a Dual 8-Port Hybrid.

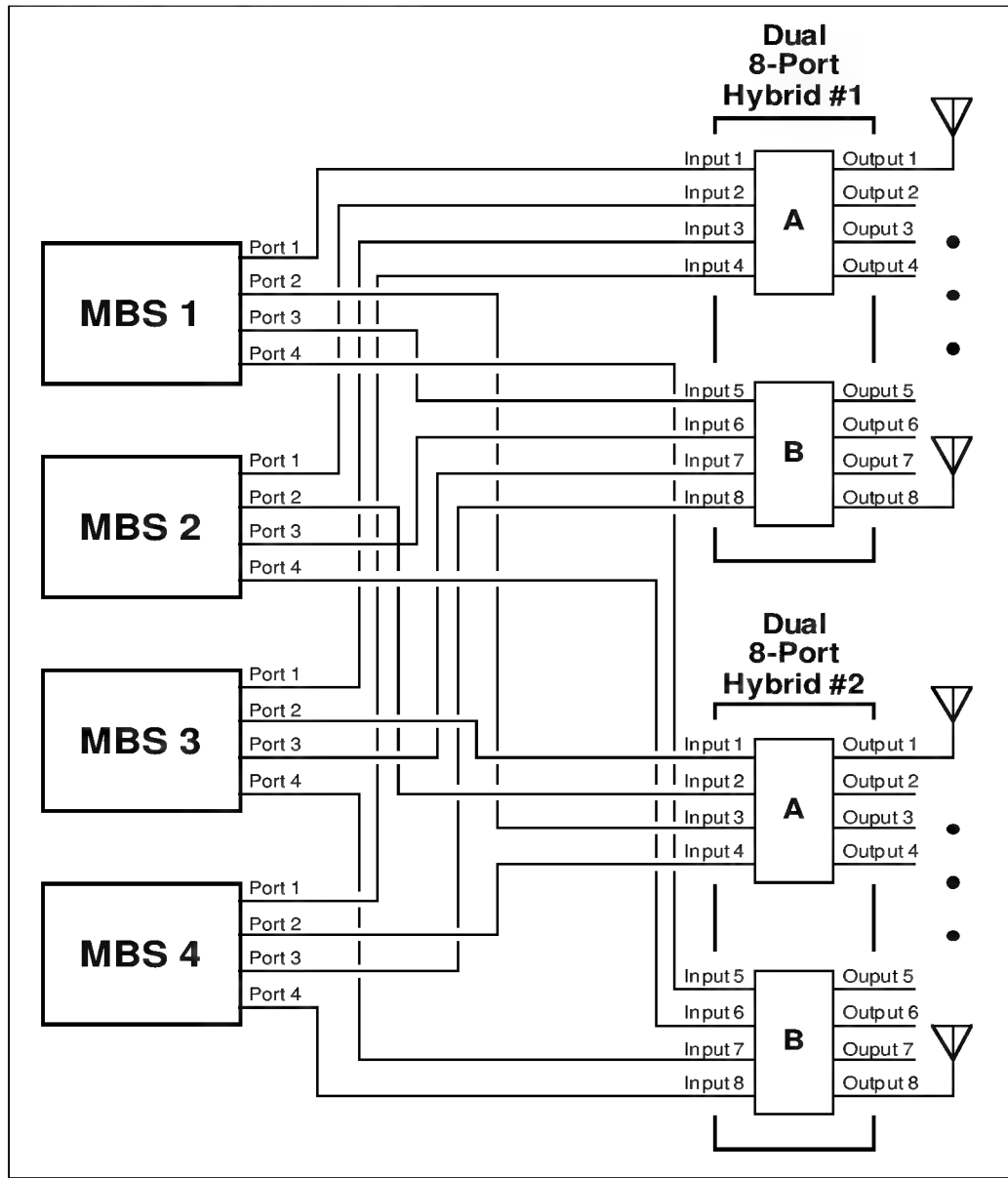
Figure 26
Configuration for 5 to 8 antennas



Antenna array with two hybrids

The two-hybrid configuration is for cells with 9 to 16 antennas, as Figure 27 illustrates. The installer must mount the hybrids near the MBSs. For this configuration, you must use two Dual 8-Port hybrids. You cannot mix 8-Port and 4-Port hybrids.

Figure 27
Configuration for 9 to 16 antennas



RF cable count

For one MBS and one to four antennas, the RF cable count must match the antenna count. This configuration requires an N-style female-to-female adapter for each RF cable to antenna cable connection.

For more than one MBS and a Dual 8-Port Hybrid, the calculation to determine the cable count follows:

$$\# \text{ RF cables} = \text{Roundup}(\# \text{ of antennas} / 4 * \# \text{ of MBSs})$$

Example:

$$\# \text{ RF cables} = \text{Roundup}(6 \text{ antennas} / 4 * 1 \text{ MBS})$$

$$\# \text{ RF cables} = \text{Roundup}(1.5 * 1)$$

$$\# \text{ RF cables} = \text{Roundup}(1.5)$$

$$\# \text{ RF cables} = 2$$

Dual 8-Port Hybrids

The following limits and characteristics apply to a Dual 8-Port Hybrid:

- Averages 7dB signal loss from input to output
- Uses N-style female connections
- Consists of two independent hybrids with four inputs and four outputs in each hybrid half
- Maximum of four MBSs and 16 antennas per cell (can use with two MBSs and eight antennas per cell)
- Hybrid N terminators required on any unused input and output ports of active sections

Dual 8-Port Hybrid count

The following guidelines apply to the number of Dual 8-Port Hybrids in a cell:

- A cell that has 1 to 4 antennas and 1 MBS requires no hybrid.
- A cell that has 1 to 4 antennas and 2 or more MBSs requires 1 hybrid.
- A cell that has 5 to 8 antennas requires 1 hybrid.
- A cell that has 9 to 16 antennas requires 2 hybrids.
- A cell can have a maximum of 2 Dual 8-Port hybrids

Terminator count for Dual 8-Port Hybrids

The calculation for the Dual 8-Port Hybrid terminator count follows:

$$\text{Roundup}((\# \text{ of antennas} / 4) * 8) - (\# \text{ of RF cables} + \# \text{ of antennas})$$

Example:

$$\# \text{ terminators} = \text{Roundup}((6 \text{ antennas}/4) * 8) - (3 \text{ RF} + 6 \text{ antennas})$$

$$\# \text{ terminators} = \text{Roundup}(1.5 * 8) - 9$$

$$\# \text{ terminators} = \text{Roundup}(12) - 9$$

$$\# \text{ terminators} = 3$$

Quad 4-Port Hybrids

The following limits and characteristics apply to a Quad 4-Port Hybrid:

- Averages 3dB signal loss from input to output
- Uses N-style female connections
- Consists of four independent hybrids with two inputs and two outputs in each hybrid quarter
- Hybrid N terminators required on any unused input and output ports of active sections
- Maximum of one hybrid per cell
- Maximum of two MBSs and eight antennas per hybrid

Quad 4-Port Hybrid count

The following guidelines apply to the number of Quad 4-Port Hybrids in a cell:

- A cell that has 1 to 4 antennas and 1 MBS requires no hybrid.
- A cell that has 1 to 4 antennas and 2 MBSs requires 1 hybrid.
- A cell that has 5 to 8 antennas requires 1 hybrid.
- If a cell has more than 8 antennas, use two Dual 8-Port Hybrids instead of the Quad 4-Port, or split the cell.
- If the cell requires more than 2 MBSs, split the cell or use a Dual-8-Port Hybrid.

Terminator count for Quad 4-Port Hybrids

The calculation for the Quad 4-Port Hybrid terminator count follows:

$$\text{Roundup}((\# \text{ of antennas} / 2) * 4) - (\# \text{ of RF cables} + \# \text{ of antennas})$$

Coaxial cable

To connect an antenna to a hybrid or MBS, Nortel recommends 1/2 in. coaxial cable because of its low-loss characteristics. The maximum cable length for each size of cable—1/4 in., or 3/8 in., or 1/2 in.—depends on the signal-loss characteristic (attenuation) of the type of cable.

Cable for a Microcellular system usually runs through plenums. A plenum is an enclosed area that is part of the building's air distribution system and is connected to at least one air duct. Plenum-rated cable is required if cable runs through a plenum.

Cable types

To specify the type of cable, you need to know the local building and fire safety codes at the site and if possible, the cable routes. For example, if the cable does not need to go through an air plenum, the design can specify a nonplenum cable, which is less expensive. You can choose from the following four types of coaxial cable, listed from the most fire resistant to the least:

- CATVP plenum cable, for wiring in air ducts and plenum areas
Nortel recommends CATVP cable for all Microcellular cabling.
- CATVR riser cable, for wiring in vertical runs
- CATV general purpose coaxial cable, for wiring in most other places
- CATVX limited use coaxial cable, for wiring enclosed in a raceway, exposed wiring less than 10 ft. long, and small diameter wiring in dwellings.

You can substitute CATVP or CATVR cable for CATV cable.

Cable standards

The U.S. National Electrical Code (NEC), which sets the standards for coaxial cable inside buildings, requires CATVP cables in ducts, plenums, or other environmental air spaces that do not have additional protection, such as the area above a false ceiling. CATVP cables, which Nortel recommends for

all Microcellular cable runs, have high resistance to fire and low smoke emission.

All other types of cables, listed as CATVX or higher, must have a surrounding barrier, such as a metal conduit or metallic tubing.

N-style male coax connector count

The N-style male coax connector count equals twice the antenna count.

TRU-IIs

To determine the number of TRU-IIs for the Microcellular system, see “Traffic calculations” on page 62.

One TRU-II must always be dedicated to the control channel. All other TRU-IIs can be traffic radios (TDMA-3 voice or AMPS data).

Microcellular Base Stations (MBSs)

Use the number of TRU-IIs from the traffic calculations for all the cells to determine the number of MBSs for the Microcellular system. An MBS can have from 1 to 4 TRU-IIs, typically a minimum of two, one for the CCH and one for the VCH. The following limits and characteristics also apply to an MBS:

- Cannot be split to cover more than one partition
- Has four TNC antenna ports
- Should be located near the center of the cell to limit coaxial cable length
- Must be co-located with all MBSs in the cell
- TNC terminators required on unused ports
- 3,000 ft. maximum TCM length from the Meridian 1 system

MBS count

The calculation to determine the MBS count for a cell follows:

$$\# \text{ MBSs} = \text{Roundup}((\# \text{ of voice channels} + (1)\text{CCH}) / 4)$$

MBS terminator count

The calculation for the MBS terminator (TNC) count follows:

$$(\# \text{ of MBS}) * 4 - (\# \text{ of RF cables})$$

Automatic Frequency Planning (AFP) Stations

To determine the number of AFP Stations, you need the length and width of the coverage area. Each AFPS can cover approximately 100,000 square feet of floor space.

For example, to determine the number of AFP Stations for a two-story building, you need to take into account only the length and width (X and Y) measurements of the building. If the length of the building is 600 ft and the width is 200 ft, the building has a floor area of 120,000 sq ft and needs two AFP Stations.

The following guidelines apply to the deployment of AFP Stations:

- A Microcellular system can have up to 12 AFP Stations (Option 11C, 51C, 61C, 81, or 81C)
- Each AFPS can cover approximately 100,000 square feet of floor space, based on the length and width of the building
- Place AFP Stations at the highest points of the Microcellular site.
- Place multiple AFP Stations as far from each other as possible.
- Do not place an AFPS within 30 feet of a Microcellular antenna or near metal.
- Do not place an AFPS in an air plenum area of the ceiling.
- Do not place an AFPS more than 3,000 feet from the Meridian 1 system if you are using a TCM connection between the AFPS and the MSM MAT because the AFPS cannot be more than 3,000 feet from its DLC port. With a serial connection between an AFPS and the MSM MAT, the AFPS can be farther away from the Meridian 1 system.

Meridian 1 Microcellular hardware

Meridian 1 hardware for a Microcellular system consists of circuit packs that are specific to the Microcellular option:

— MISP

- Required in an Option 51C, 61C, 81, or 81C system
- Not used in an Option 11C system

— EIMC

- One per IPE module
- Operates in any IPE slot
- One per Option 11C system, located only in the main cabinet
- One per Microcellular zone
- Up to 3 in an Option 51C system
- Up to 7 in an Option 61C system
- Up to 8 in an Option 81 or 81C system
- Cannot be shared with ISDN

— MXC

- One to 15 per IPE shelf. For a VSELP-only system, up to 12 MXCs per superloop may be configured.
- One to 15 per Option 11C system, located in any cabinet
- One to 15 per EIMC. For a VSELP-only system, up to 12 MXCs per superloop may be configured.
- Operates in any IPE slot
- Supports one control-channel radio and up to 3 traffic radios for ACELP/VSELP or one control-channel radio and up to 7 traffic radios for a VSELP cell (TDMA-3 voice or AMPS data)

Preliminary equipment list

Include the following hardware, software, and tools in a preliminary equipment list for a Microcellular site. The site planner uses information from this list and Meridian Configurator to prepare a quote for the customer.

- a** Meridian 1 prerequisites to support the Microcellular system
- b** Nortel system package of Microcellular hardware and software
- c** Additional Microcellular parts for extra Meridian 1 cards, documents, Field Replaceable Components, planning and deployment tools, and spares
- d** Coaxial cable, TCM cable, and connectors provided by other manufacturers

Prerequisite Meridian 1 hardware and software

To run a Microcellular system on an Option 51C, 61C, 81, or 81C Meridian 1 Release 23 system, the customer needs the following products:

- SW000I X11R23 Base Software
 - BRI (216)
 - Phantom TN (254)
- SW0500A Mobility Microcellular Software
 - MOSR (302)
 - MMO (303)
- Microcellular MAT Package
 - Alm_Filter (243)
 - LAPW (164)
 - MULI (242)
 - MAT (296)

To run a Microcellular system on an Option 11C Meridian 1 Release 23 system, the customer needs the following products:

- NTSF8020 Opt 11 R23 Software - General Business
 - BRI (216)
 - Phantom TN (254)
- SW0501A Mobility Microcellular Software
 - MOSR (302)
 - MMO (303)
- Microcellular MAT Package
 - Alrm_Filter (243)
 - LAPW (164)
 - MULI (242)
 - MAT (296)

The following packages, for Multi-Site Networking, are optional:

- MMSN (314)
- ISDN (145)
- PRA (146) (1.5 Mbytes)
- ISL (147)
- Ntwk_Srv (148)
- NARS (58) or CDP (59)

If the AFP Station or Stations will use TCM connections, the Meridian 1 system also needs a Digital Line Card (DLC). The customer needs one DLC port on the Meridian 1 system for each AFP Station and one DLC port for the Meridian Communications Unit (MCU). Alternatively, the AFP Station or Stations can use a serial connection to the local MSM MAT, through short-haul modems.

On the preliminary equipment list, specify any prerequisites the Meridian 1 system does not already have. (If the site does not have a Meridian 1 system, include it as a prerequisite.)

System packages for Microcellular systems

Nortel provides the following Microcellular system packages for Meridian 1 Option 51C, 61C, 81, and 81C systems:

- SY2001 Mobility Microcellular Server Package (required)
 - Meridian 1 Microcellular cards
 - 1 MISP
 - 1 EIMC
 - 1 MXC
 - 1 MBS with 2 TRU-II's
 - AFP components
 - 1 AFP Station
 - 1 external antenna
 - 1 local, plug-top power supply for the AFP Station (in some cases, you can use a Remote Power Interconnect (RPI) unit and TCM cable instead)
 - 1 Meridian Communications Unit with RS-232 modem pool cable
 - 1 local, plug-top power supply for the MCU
 - 1 instruction manual for the AFP Station
 - 1 set of Microcellular documents (NTPs) and 1 feature card.
- SW0500A Mobility Microcellular Software (302/303) (required)
- NTZK93AA Mobility System Management (MSM), with the AFP feature (required)
- MAT to run MSM (required, CD-ROM drive recommended)
- SW0502A Multi-Site Microcellular Networking (314) (optional)

Nortel provides the following Microcellular system packages for Meridian 1 Option 11C systems:

- SY2000 Mobility Microcellular Server Package (required):
 - Meridian 1 Microcellular cards:
 - 1 EIMC
 - 1 MXC
 - 1 MBS with 2 TRU-II's
 - AFP components:
 - 1 AFP Station
 - 1 external antenna
 - 1 local, plug-top power supply for the AFP Station (in some cases, you can use a Remote Power Interconnect (RPI) unit and TCM cable instead)
 - 1 Meridian Communications Unit with RS-232 modem pool cable
 - 1 local, plug-top power supply for the MCU
 - 1 instruction manual for the AFP Station
 - 1 40-megabyte PCMCIA card
 - 1 16-megabyte SIMM
 - 1 set of Microcellular documents (NTPs) and 1 feature card.
- SW0501A Mobility Microcellular Software (302/303) (required)
- NTZK93AA Mobility System Management (MSM), with the AFP feature (required)
- MAT to run MSM (required, CD-ROM drive recommended)
- SW0503A Multi-Site Microcellular Networking (314) (optional)

On the preliminary equipment list, specify the system packages for the Microcellular system.

Antenna system hardware

Nortel provides the following hardware for antenna array installation and maintenance:

- Antennas (at least one required)
 - AO609534 directional antenna
 - AO659298 omnidirectional antenna
- Hybrids (as needed)
 - AO617457 Quad 4-Port Hybrid
 - AO617460 Dual 8-Port Hybrid
- AO609689 Hybrid terminator (as needed)
- Connectors (as needed)
 - A0600384 female-female connector
 - A0615483 male connector

On the preliminary equipment list, specify the antenna or antennas for the Microcellular system and the estimated number of hybrids, terminators, and connectors needed for antenna installation.

Radio system hardware

Nortel provides the following hardware for MBS and TRU-II installation and maintenance:

- MBS mounting hardware (at least one type required)
 - NTLA50AA Wall Mount
 - NTLA51AA Seismic Floor Mount
 - NTLA52AA Rack Mount
 - NTLA53AA Standard Floor Mount
- SY2002 Mobility Microcellular Base Station Expansion Kit, which contains one MBS and one TRU-II (as needed for additional Base Stations and TRU-IIs)
- NTAX98AA TRU-II (as needed for additional TRU-IIs and spares)

- NTLA0002 MBS terminator (as needed for unused MBS ports)
- NTLA0001 RF antenna cable (as needed)

On the preliminary equipment list, specify mounting hardware for each MBS, any additional MBSs and TRU-IIs, at least one TRU-II for a spare, MBS terminators for unused ports and spares, and the estimated amount of RF antenna cable.

AFP hardware

Nortel provides following hardware for AFP installation:

- AFP Station and accessories:
 - External antenna
 - Local, plug-top power supply
- Meridian Communications Unit (MCU) and accessories
 - Local, plug-top power supply
 - RS-232 modem pool cable

For a TCM connection, an AFP Station can be up to 3,000 ft from a DLC port. Up to 3,000 ft of TCM cable is required for each TCM interface between an AFP Station and its DLC port or between the MCU and its DLC port.

Alternatively, each AFP Station can connect directly to the local MSM MAT via a serial connection, using two short-haul modems (for example, SRM-5A or SRM-5D miniature asynchronized short-range modem from RAD Data Communications, Ltd.). This connection requires an RS-232 modem pool cable for each modem and phone cable between the modems.

Instead of the local power supplies, AFP Stations can use a Remote Power Interconnect (RPI) unit and TCM cable to supply power remotely.

Additional Microcellular parts

In your preliminary equipment list, include additional Microcellular parts for Meridian 1 cards, documents, Field Replaceable Components, deployment tools, and spares. Table 4 lists additional parts that Nortel provides.

Table 4
Additional parts

Nortel part number	Description
SY2003	Microcellular Planning and Deployment Tools
SY2004	Mobility Microcellular Spares Package (contains 1 EIMC, 1 MXC, and 1 TRU-II)
NT6D73AA	MISP Card
NT7R01CA	Embedded Intelligent Mobility Controller Card (EIMC)
NTEX80AB	Microcellular Transcoder Card (MXC)
NTAX98AA	TRU-II (radio) (Field Replaceable Component, part of MBS Assembly)
NTLA00AA	MBS without TRU-II
NTLA30AA	Antenna Matrix/Oscillator (AMO) (Field Replaceable Component, part of MBS Assembly)
NTLA40AA	Alarm/Power Supply Module (APS) (Field Replaceable Component, part of MBS Assembly)
P0725473	MBS Fan (Field Replaceable Component, part of MBS Assembly)
NTLA50AA	MBS Wall Mount hardware
NTLA51AA	MBS Seismic Floor Mount hardware
NTLA52AA	MBS Rack Mount hardware
NTLA53AA	MBS Standard Floor Mount hardware
NTLA0001	RF antenna cable
NTLA0020	MBS interface cable
NTLA0010	AC cord
NTLA0002	MBS TNC terminator
A0609689	Hybrid terminator, 50-ohm "N" male

Nortel part number Description

A0615483	Connector, "N" male 1/2"
A0600384	Connector, junction "N<-->N" female 1/2"
A0617457	Hybrid, Quad 4-Port
A0617460	Hybrid, Dual 8-Port
A0609534	Indoor antenna, directional
A0659298	Indoor antenna, omnidirectional
NT7R0901	Automatic Frequency Planning Station (AFPS)
NTE018AA	Remote Power Interconnect Unit 8 (RPI8)
NTE019AA	Remote Power Interconnect Unit 16 (RPI16)
NT2K65XJ	Meridian Communications Unit (MCU)
QCAD5B	RS-232 modem pool cable
A0633651	Option 11C 40Mb PCMCIA
A0659257	Option 11C 16Mb memory
P0879504	Mobility Microcellular NTP
P0841607	Mobility Microcellular Feature Card (20 each)

Coaxial cable and connectors

The following hardware items required for a Microcellular system are not provided by Nortel. These items can be purchased from various suppliers. Nortel recommends 1/2" low-loss coaxial cable, 3dB loss per 100 m (328 ft) or better.

1/2" plenum coaxial cable
1/2" standard coaxial cable
3/8" plenum coaxial cable
3/8" standard coaxial cable
3/8" male N connector
1/4" plenum coaxial cable
1/4" standard coaxial cable
1/4" male N connector
1/4" male N connector, plenum

WARNING

The Microcellular system is not designed to operate with high-loss RG cable.

Table 5 lists the Andrew corporation's part numbers for these cables and connectors.

Table 5
Andrew cables and connectors

Cable description	Andrew cable #	Andrew connector #
1/4 in. Helix superflexible standard jacket	FSJ1-50A	F1PNM-H (41PW)
1/4 in. Helix superflexible plenum	ETS1-50T	F1PNM-H (41PW)
1/4 in. Helix air dielectric plenum	HS1RP-50	F1PNM-H (C41SW)
3/8 in. Helix foam dielectric standard jacket	LDF2-50	L2PNM (L42PW)
3/8 in. Helix foam dielectric superflexible, plenum	ETS2-50T	F2PNM (42SPW)
1/2 in. Helix superflexible standard jacket	FSJ4-50B	F4PNM (44SEW)
1/2 in. Helix foam dielectric standard jacket	LDF4-50A	L4PNM (L44PW)
1/2 in. Helix air dielectric plenum	HL4RP-50	L4PNM (L44PW)

Table 6 lists some manufacturer part numbers for two widely used terminators. For Nortel part numbers, see Table 4 on page 81.

Table 6
Part numbers for two terminators

MBS TNC 50-ohm terminator	
Manufacturer	Part number
Huber & Suhner	65TNC-50-0-1/133
Rosenberger	565155-010A4
Hybrid 50-ohm 1-watt terminator	
Manufacturer	Part number
Andrew	50T-007
Huber & Suhner	AG 65N-50-0-11/122
Radiall	R404-130

Preliminary design report and quote

Include the following documents in the preliminary design report:

- Preliminary equipment list
- Any marked-up floor plans or building sketches
- A clean copy of the floor plans or sketches for the site planner to mark up
- The Customer Information Form
- For the IS-54B protocol, RSSI readings

Enter information from the IMCS simulation, the Customer Information Form, and the preliminary equipment list into Meridian Configurator to generate a preliminary system price. Base your quote on the cost of all the Microcellular equipment and software plus the cost of site planning and installation services.

If the customer needs to upgrade a Meridian 1 system before installing the Microcellular system, such as replacing the CPU on an Option 11 system to upgrade to an Option 11C system, include an estimated upgrade cost in your quote. To determine whether a customer's Meridian 1 system needs an upgrade, refer to the Customer Information Form in Appendix A.

Detailed design overview

The detailed design produces the deployment and provisioning information for installation. The preliminary design, produced by the IMCS software, provides a starting point for the detailed design. To gather more precise information for the detailed design, you need to go to the site with the following equipment and supplies:

- Microcellular deployment tools, described in detail on page 89:
 - Signal source
 - ZK-SAM receiver
 - Omni antenna and directional antenna
 - Laptop computer with Microcell Deployment Data Collection (MDDC) software, a DOS 3.3 application
 - Accessories for using and carrying the equipment
- Preliminary design documents, including the two-page customer questionnaire and, for IS-54-B, RSSI readings
- Marked-up floor plans
- Clean copies of the floor plans to mark up
- This *Site planning and deployment guide*

At the Microcellular site, you use MDDC on the laptop computer connected to the ZK-SAM receiver to measure control-channel interference and path loss measurements. Then you use these actual measurements to adjust the preliminary design plan.

For the detailed design, you need to determine the actual placement, with tolerance ranges, and connections for the all antennas, hybrids, and MBSs at the site. You also need to determine cable routes and determine the sizes and amounts of cable needed for installation.

The output from the detailed design is a design report to use for Microcellular system installation. The design report should include the following documents and information:

- Marked-up floor plans and sketches, showing the placement of AFP Stations, antennas, hybrids, and MBSs, with tolerance ranges
- Connection tables or charts describing antenna to MBS connections, antenna to hybrid connections, and hybrid to MBS connections
- A table or chart describing the TCM wiring between MBSs and the Meridian 1 system
- Placement of the modem and phone line for the CMCP connection
- Placement of Microcellular cards in the Meridian 1 system
- Provisioning of Microcellular equipment, cable, cards, and software

In most cases, the hardware requirements of this detailed design are 95% accurate.

Microcellular deployment tools

Nortel recommends the following tools for deployment of a Microcellular antenna system:

- Signal source
- ZK-SAM receiver
- Omni antenna and directional antenna
- Measuring wheel (if floor plans are not available)
- Laptop computer with Microcell Deployment Data Collection (MDDC) software, a DOS 3.3 application (MDDC is part of the Nortel SY2003 Microcellular Planning and Deployment Tools.)
- Accessories for using and carrying the equipment

Signal source

For a signal source, Nortel recommends the PathTraxx Model PTTX860, which produces radio frequency (RF) waveforms for use in the 800 MHz band, with a maximum output of +30dBm. This signal source is available from Chesapeake Microwave Technologies, (717) 235-1655.

Receiver

Nortel recommends the ZK-SAM receiver to monitor radio control channels in both the A & B bands, for interference measurements. The ZK-SAM portable package includes a black control box, an Oki cellular handset that connects to the control box through a special cable, and an external battery and battery connection cable.

The ZK-SAM is available from ZK CELLTEST INC., (408) 986-8080.

Antennas

To broadcast radio frequencies during deployment, Nortel recommends that you take one directional antenna and one omni antenna to the site, even if the preliminary design does not specify both kinds of antennas.

Laptop computer

You can use a laptop computer with the ZK-SAM unit to record the Microcell Deployment Data Collection (MDDC) output.

MDDC software is a tool to help you collect RF characteristic information in a microcell environment. This RF information includes control-channel interferences and radio-signal propagation models. This software runs on a DOS-based PC (DOS 3.3) and works in conjunction with the ZK-SAM to record or collect the Received Signal Strength Indicator (RSSI) measurements.

Measuring wheel

To measure distances when floor plans are not available, you can obtain a measuring wheel from Relatape Corporation.

Accessories

Nortel recommends the following deployment accessories:

- Battery chargers for the signal source, the ZK-SAM, and the laptop converter
- Power converter, if the site does not have 120/220 V AC power
- Tape measure
- 120 V AC extension cords
- Duct tape
- RF cable for the connection from the signal source to the antenna

Microcell Deployment Data Collection (MDDC)

Microcell deployment data collection (MDDC) software is a tool to help people collect RF characteristic information in a microcell environment. This RF information includes control channel interferences and a radio signal propagation model.

RF information collection is a lengthy and tedious process. People will usually get a lot of data from measurements.

To prepare the final design, you need to run the MDDC software on a laptop computer connected to a ZK-SAM cell site monitor. The ZK-SAM cable connects to the computer through a serial communications port.

MDDC software has a structured file name convention. The file names might look strange at first, but the convention is very useful, especially when you have a lot of measured data.

MDDC is a menu-driven program. After you execute the program, MDDC displays a menu on the left side of the screen with a highlighted bar inside. You can use the Up arrow and Down arrow keys to move the highlighted bar. To choose a specific command, you move the highlighted bar to that command and then press Return. The Escape key exits from current task. MDDC displays function keys, such as <F5>, when they are available.

Setting up the test equipment

The MDDC software needs two pieces of equipment, an IBM PC compatible laptop computer and a ZK-SAM cell site monitor.

The ZK-SAM portable package includes a black control box, a cellular handset that connects to the control box through a special cable, and an external battery and battery connection cable.

The connection between the ZK-SAM portable and laptop computer is through a serial communications port that needs a customized cable. This ZK-SAM portable package also includes this cable.

Since the ZK-SAM portable uses a serial communications port to communicate with a PC, before this software can operate properly, the program has to know which port is used on this computer. The default setting for the communications port in the MDDC software is COM1. After starting the software, you can change the setting to COM2 through the **Setup** command on the main menu.

Initializing a Microcellular design project

To begin your detailed design, start the MDDC software. Figure 28 shows the MDDC main menu.

Figure 28
Microcell Deployment Data Collection (MDDC) main menu

BNR
2H31
V0.91

Create_Project
Select_Project

Description

Interference_A
Interference_B
PathLoss

Setup
Battery

Frequency
Shell
Exit

Project

Description

First you need to create a project for the Microcellular site:

- 1 Choose **Create_Project** from the main menu.
- 2 Type a three-character project name.
- 3 Choose Description from the main menu.
- 4 Enter a short description of the site, for your information.

Next, divide the site into small measurement areas:

- 1 Divide the site into floors, from 00 to 99. The default floor number is 01.
- 2 Divide each floor into up to nine zones, numbered from 1 to 9. The default zone number is 1.

3 Divide each zone into up to five directions:

- a** C (center)
- b** E (east)
- c** W (west)
- d** S (south)
- e** N (north)

The default direction is C. After the division, each direction is a measurement area for control-channel interference and path loss measurements.

In many cases, one floor, zone, or direction is enough for the division. If the site has metal walls or thick concrete walls, you need to use more zones to break up the building into smaller areas.

Measuring control-channel interference

For frequency planning, you need to know the maximum control-channel interference at the Microcellular site.

Conduct a control-channel interference measurement for each measurement area as follows:

- 1** Select the Microcellular site project from the MDDC main menu screen.
- 2** Choose the appropriate interference command, such as **Interference_B**.
- 3** Choose the **Info** command and enter the floor number, zone number, and direction for the measurement.
- 4** Press the Escape key on your keyboard to return to the interference menu.
- 5** If you want to record any extra information about the measurement, choose the **Header** command and type the information in the header box.

- 6 For a standard situation, there are 21 control channels in each system (A and B). If you need to measure the interference from more control channels, choose the **CCH** command, which enables you to edit the control-channel table on the right of the screen. Use the Insert key on your keyboard to add a channel and the Delete key to delete a channel. Highlight channel information that you want to change and type the new information. When you finish editing the control-channel table, press the Escape key.
- 7 To start the measurement, choose the **Run** command. MDDC collects RSSI readings for each channel up to 80 times. MDDC presents RSSI readings on the screen in two different windows. You can press the Escape key at any time to stop the measurements.
- 8 Choose the **Save** command to save the results. Use the following file name format to simplify keeping track of different measurements:

pppffds.mzc

In the file name format, ppp is the three-character project name, ff is the floor number, d is the direction, s is the system (A or B), m is the type of measurement (I for control-channel interference or P for path loss), z is the zone number, and c is the category (D for raw data produced by the **Run** command, R for the result—analyzed data, and S for scanned data produced by the **Scan** command).

The control-channel table on the right side of the screen shows the average RSSI reading for every channel.

- 9 The window on the bottom of the screen displays the true RSSI readings for each channel, one channel at a time. Use the F5 key to switch between graphic display and numerical display for this window.

Measuring path loss

To refine your preliminary design, you need to know the attenuation of a signal throughout the building. Then you can enter actual path loss values into IMCS and rerun the preliminary design simulation.

Path loss measurements require an external signal generator. Conduct path loss measurements for each measurement area as follows:

- 1 Select the Microcellular site project from the MDDC main menu screen.
- 2 Choose the **Pathloss** command.

- 3 Choose the **Info** command and enter the floor number, zone number, and direction for the measurement.
- 4 Press the Escape key on your keyboard to return to the interference menu.
- 5 If you want to record any extra information about the measurement, choose the **Header** command and type the information in the header box.
- 6 Choose the **Channel** command to set up a channel (frequency) for measurement. The **FREQ.** box should display the actual downlink frequency for this channel.
- 7 Choose the **InitPWR** command and enter the transmitter power value. This is the value used for a one-meter reference measurement. Adjust the signal generator to this level.
- 8 Check the location marker box. If it does not display “REF”, choose the **LocMark** command to modify the box to display “REF”.
- 9 Choose the **Run** command to start the reference measurement. MDDC displays ten readings in a popup window. If you press the space bar, MDDC records these readings; if not, MDDC skips the readings. Every time you press the space bar, MDDC calculates the accumulated average RSSI level and displays the result in the upper right corner of the REF box. Press the Escape key on your laptop keyboard to stop this process.
- 10 To verify that the reference measurement has been done, check the REF box to see if it displays an average reference RSSI level.
- 11 Choose the **LocMark** command and enter a location marker for the position where you are going to perform path loss measurements.
- 12 Choose the **Power** command and enter the transmitter power value. This is the value used for measurement at the current location. Adjust the signal generator power to this level.
- 13 Choose the **Run** command to start the measurements. MDDC records ten RSSI readings every time you press the space bar and displays the readings in the record table at the bottom right of the screen. Press the Escape key to stop the measurements.

- 14 Press the Tab key to move the highlight bar into the record table. Use the Up and Down keys to move the bar to recently collected data and then press the Enter key. A popup edit box appears on the screen. Enter the real distance for this location and press the Enter key.
- 15 With the highlight bar still in the record table, press the F5 key. MDDC fills in the distance value for all the other records of the same location. Press the Tab key to return to the path loss menu.
- 16 Repeat from step 11 for another location until you have done all the locations.
- 17 Choose the **Save** command to save the results. Use the following file name format to simplify keeping track of different measurements:

pppffd.mzc

In the file name format, ppp is the three-character project name, ff is the floor number, d is the direction, m is the type of measurement (I for control-channel interference or P for path loss), z is the zone number, and c is the category (D for raw data produced by the **Run** command, R for the result—analyzed data, and S for scanned data produced by the **Scan** command).

- 18 After you complete path loss measurements in one direction, choose the **Analyze** command to calculate the propagation model. For **Analyze** to work correctly, you need path loss data for at least three locations. You also need to enter the distance value for each location before invoking the analyze command.

If you rerun the IMCS simulation to prepare a detailed design for a Microcellular system, you might want to import the path loss values from the MDDC output files.

Verifying RF coverage by scanning

The **Scan** command is a verification utility. This command puts the MDDC program into a continuous scanning mode. When you press the space bar during the scanning process, the program puts a numerical marker behind the RSSI reading at that location.

You can use this scan function to verify the coverage after the completion of system installation:

- 1 Turn on the Microcellular system with one control channel continuously sending out the signal.
- 2 Choose the **Scan** command and walk around the entire coverage area.
- 3 Press the Escape key to finish the scan.
- 4 MDDC automatically saves the data in a scan file with a percentile coverage table.

Checking battery status

The battery status checking function sends a signal to the ZK-SAM portable to check how long the battery can last. The response is either “BATTERY H” or “BATTERY L” at the right bottom corner of the screen.

“BATTERY H” means the battery can last at least 15 minutes.

“BATTERY L” means that you need to recharge the battery or plug in another external battery.

To start this function, choose the **Battery** command from the main menu and then choose **ON**.

Calculating frequencies

It is difficult to memorize all the up link and down link frequencies for every channel, especially for many channels. MDDC has a small utility that calculates the corresponding up link and down link frequencies when you type in the channel number, or vice versa. To invoke this utility, choose the **Frequency** command from the main menu.

Design Verification

The ultimate design goal for each IS-136 cell in the Microcellular system is to have -85dBm or greater signal strength in 95% of the coverage area. For each IS-54B cell, the design goal is to have the best server signal strength, 3dBm to 5dBm greater than any other signal in the coverage area.

To verify the design, for each antenna location on the floor plans, place an antenna at that position, adjust your RF generator to produce the signal output you expect, and then measure the cell boundary values. In an IS-136 cell, 95% of these values should be -85dBm or greater. In an IS-54B cell, 95% of these values should be at least 3dBm to 5dBm greater than any other signal.

If any of the values are not what you expect, you can redo the design manually. First try moving antennas and adjusting directional antennas to different degrees of rotation. Then try adding antennas for better coverage. If you move or add an antenna to your design, you might need to adjust the location of an AFP Station to keep it a minimum of 30 ft away from the antenna.

Antenna placement and cabling

To determine actual antenna placement and cabling, start with the preliminary design that you adjusted and verified after the MDDC measurements and perform the following steps:

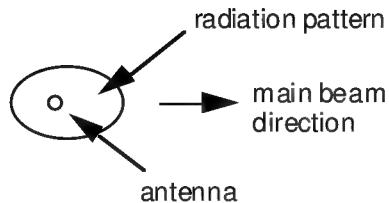
- 1 Clearly mark the cells on the floor plans. If you use preinstalled cable protection systems, accurately mark them on the floor plans.
- 2 For each cell, mark the *theoretical best* antenna locations on the floor plans and then show the tolerances—see Figure 29. Mark the *actual* antenna locations, indicating the antenna orientation and using the tolerances to avoid any obstructions of the main antenna beam within three feet of the antenna (the installer needs to know the tolerances in case on-site adjustments are necessary)—see Figure 30. Uniquely identify each antenna. Incorporate the labels in the antenna configuration drawings—these are used to define the correct connectivity in the finished system. See Figure 31 for examples.
- 3 For each cell, look up the maximum cable lengths for the types of 1/4 in., 3/8 in., and 1/2 in. cable you specify and write the maximum lengths on the floor plans. (The installer might need this information if installation problems occur.)
- 4 Draw the cable route for each antenna. Accurately measure the required cable length. Be sure to include allowances for the run from the MBS to the ceiling, and from one floor to another. Uniquely identify each cable. Note on the floor plans any cable protection that might be required.
- 5 Using the maximum cable lengths for each cell, determine the required diameter for one cable. If a cable is more than 80% of the maximum length, double-check your length calculations to verify them.

- 6 Determine the type of cable to be used. Nortel recommends the 1/2 in. size to minimize signal loss, which is inversely proportional to the cable radius. Plenum and riser cables are rated according to the National Electric Code. Superflex cables have a smaller minimum bending radius than regular cables.

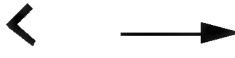
Note: If the ceiling of a space is over 15 ft high, the antennas must be mounted on poles, hung down from the ceiling, or if the building is of the appropriate dimensions, mounted on the walls.

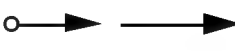
Figure 29
Antenna drawing conventions

Antennas are omnidirectional or directional. An omnidirectional antenna radiates equally in all directions. The radiation pattern of a directional antenna looks something like this:



Two conventions are used in this document to indicate antenna location and, for directional antennas, main beam direction. They are:

Convention A:  main beam direction

Convention B:  main beam direction

Convention A is often easier to draw with simple computer graphics programs, while convention B will often stand out better on cluttered floor plans. Use whichever convention seems to work best in your situation.

Figure 30
Antenna postioning requirements

Antennas must be positioned so as to avoid obstructions (like structural columns) in the main beam. In addition, it is best to avoid scattering objects (like floor-to-ceiling partition walls) in the main beam of the antenna. The following can serve as a guide:

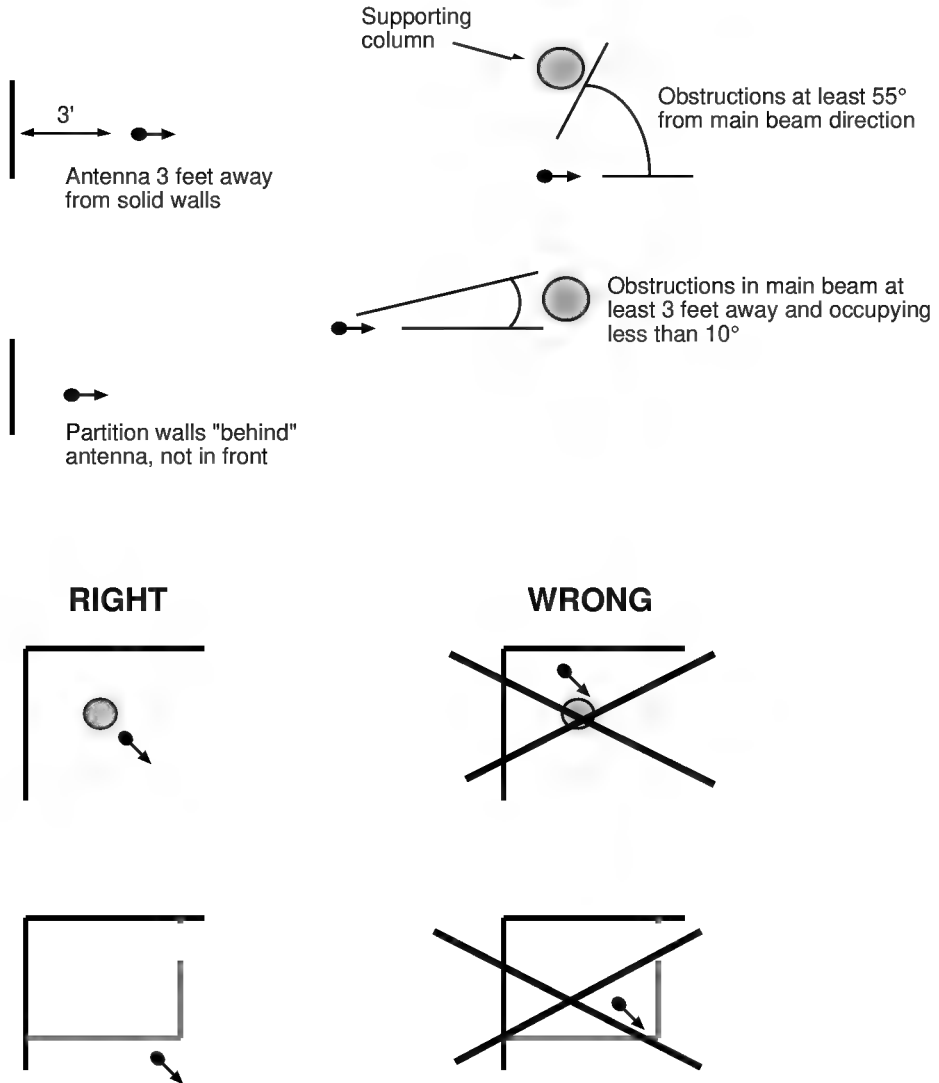
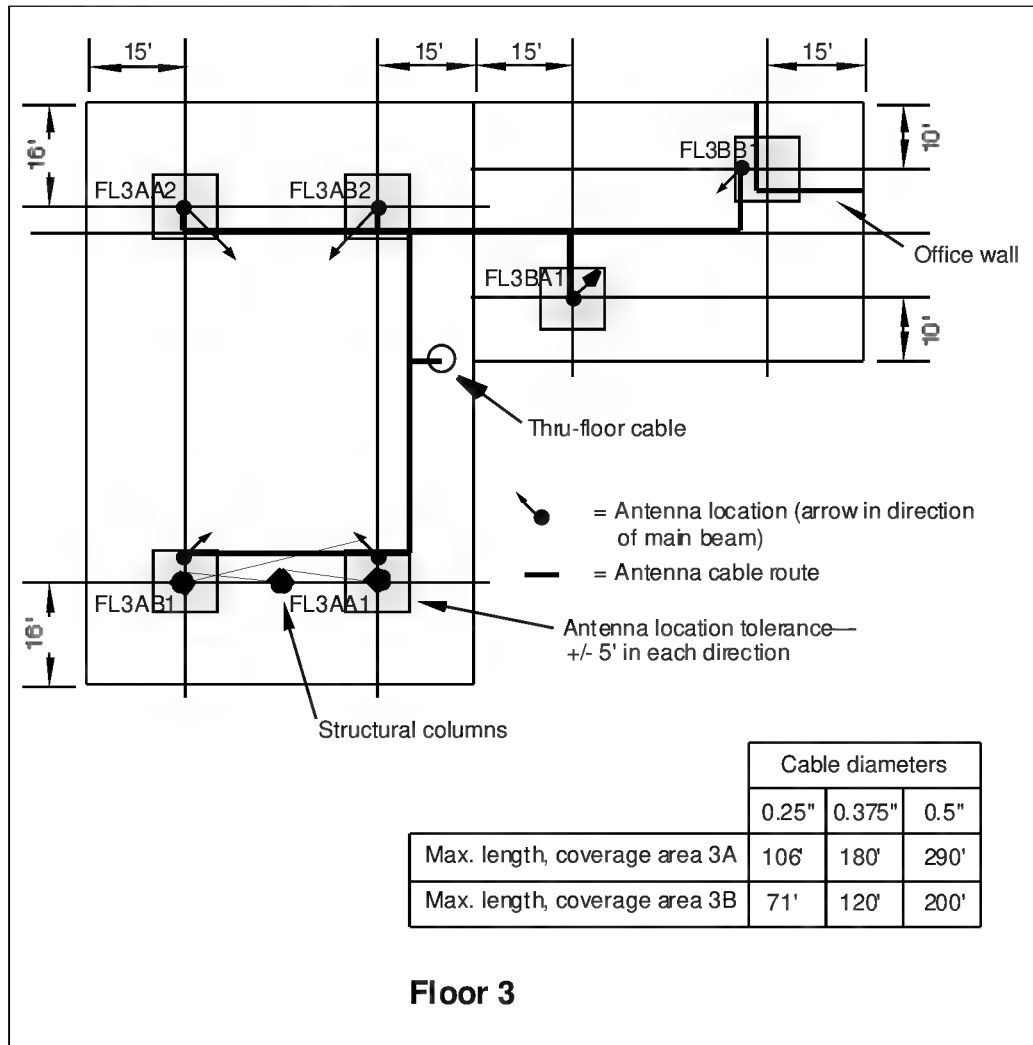


Figure 31
Example antenna locations



- 7 Repeat the process for each cable in the cell.
- 8 When you have defined all the cables in the cell, provision two connectors for each cable (these are all male connectors—the hybrid and the antenna both have female connectors). Enter the total for each type of connector.
- 9 Repeat the process for every cell in the system.

Elevator shafts

Elevator shafts tend to be surrounded by RF-impervious walls.

In an elevator shaft, a single antenna is used, placed at the center of the horizontal plane of the bottom of the shaft. (The antenna may be placed at the top of the shaft if there is no room at the bottom, as is the case in cylinder-type lifts.) If more than one elevator is enclosed in a shaft (a very common arrangement), you still need only one antenna per shaft.

Coverage gaps

A Microcellular design might require just a few feet more than the antenna system can provide in a given direction. Do not “stretch” the antenna system to fit or you will end up with large and unpredictable coverage holes.

If the customer is willing to accept a coverage compromise to minimize cost, position the antennas to place coverage gaps in areas unimportant to the customer. For instance, a coverage gap in a storeroom or next to a window might be acceptable. Be sure to get verbal agreement and written acceptance from the customer for any deviation from the originally promised coverage.

Estimated cable lengths

Antenna cable length is critical to the success of a Microcellular installation. Before making a quote, you should check that each antenna cable in a cell is shorter than the maximum permitted for each corresponding coverage area. If the maximum cable length is exceeded, you may have to either consider a different location for the MBS, or un-group some of the coverage areas in a cell. Ungrouping can require much additional equipment. To check the antenna cable lengths:

- Decide where to locate each MBS and hybrid.
- Conservatively estimate the length of the path the cable must take from the MBS or hybrid to the antenna. Be sure to make allowances for vertical runs from the equipment to the ceiling or floor, between floors, and for using preinstalled cable protection plant. If your estimate is more than 80% of the maximum cable length, you might want to take complete measurements before committing to the design.
- Check the estimated length against the maximum length of the largest cable you can use (1/2 in.).

If you come up a little long:

- 1 Make a more refined estimate. If you have been guessing at the location of cable protection plant and using only approximate locations for the antennas and MBSs, precisely locate all equipment and repeat the process. If you come up with a new number that is within the length limit, you are OK; otherwise, try the next step.
- 2 Try a different location for the MBS. Figure out which cable run is giving you the most trouble, and move the MBS so as to shorten it, and estimate the cable length again. If that does not work, try the next step.
- 3 Un-group the offending cell and those adjacent to it. Repeat the cell design, trying to keep your cable lengths down without violating any of the other cell design constraints. If that does not work, try the next step.

- 4 Consult with the customer and see if you can shorten the path from the MBS to the antenna by adding new conduits, drilling new holes through floors, and so on (remembering that this will increase your installation costs). If that does not work, try the next step.
- 5 Return to the original design and split up the cell into two or more cells. Repeat the cell design, but do not group the new cells together.

Figure 32 and Figure 33 show cable-length estimates for cell FLR3/4 of the example job. With the MBS in a telecommunications closet on the fourth floor, estimates are made only for the antennas furthest from the MBS. The offsets for the antenna locations are determined from the antenna configuration diagrams. All cables are to follow a pre-installed cable protection system in the ceiling plenum. In Figure 32, each estimate includes 10 ft for the run from the MBS to the ceiling; in Figure 33, each estimate includes 80 ft for the cable run to the riser on the fourth floor and 12 ft for the run from one floor to the next. All runs are less than the maximum lengths for each coverage area.

Figure 32
Cable length estimate for example job—fourth floor

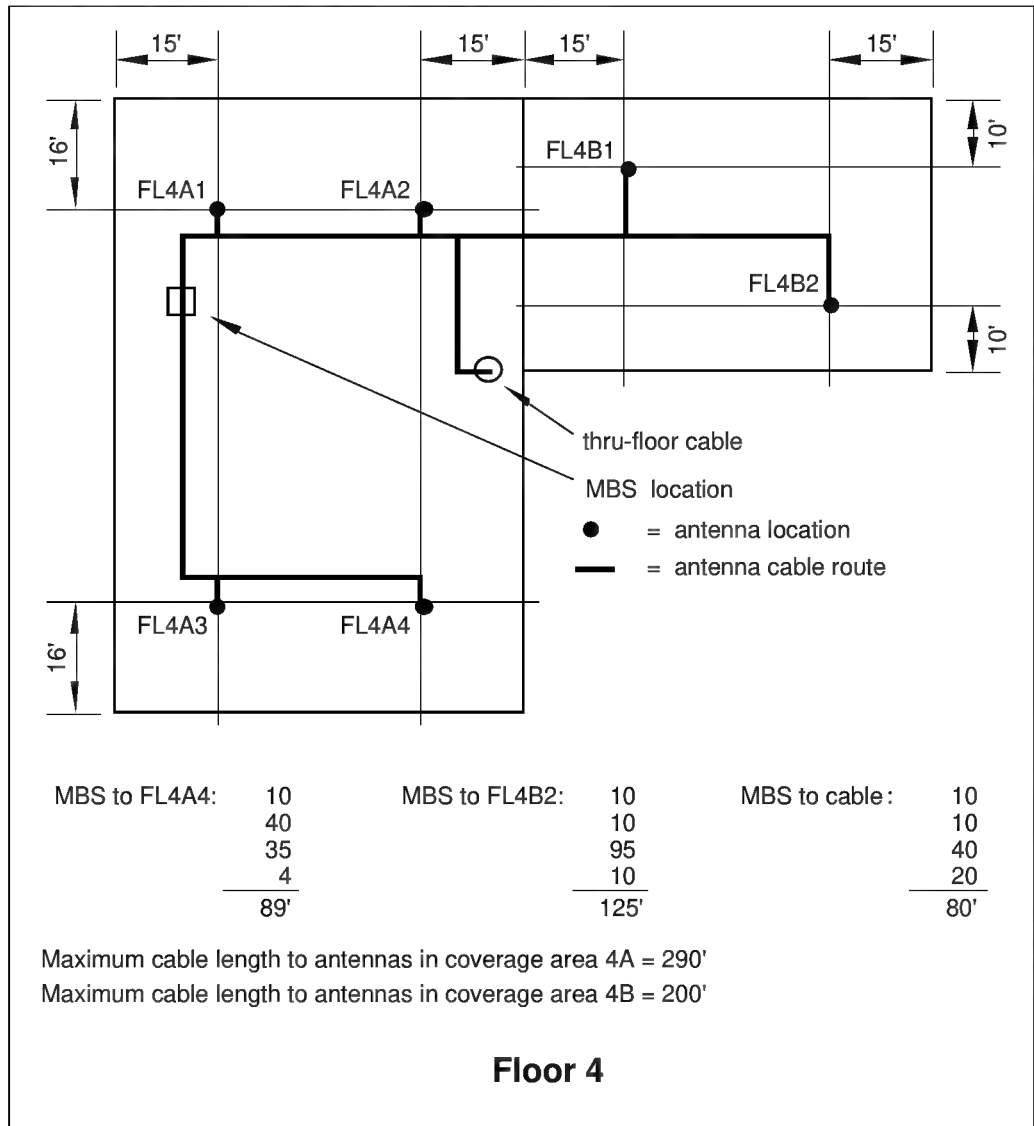
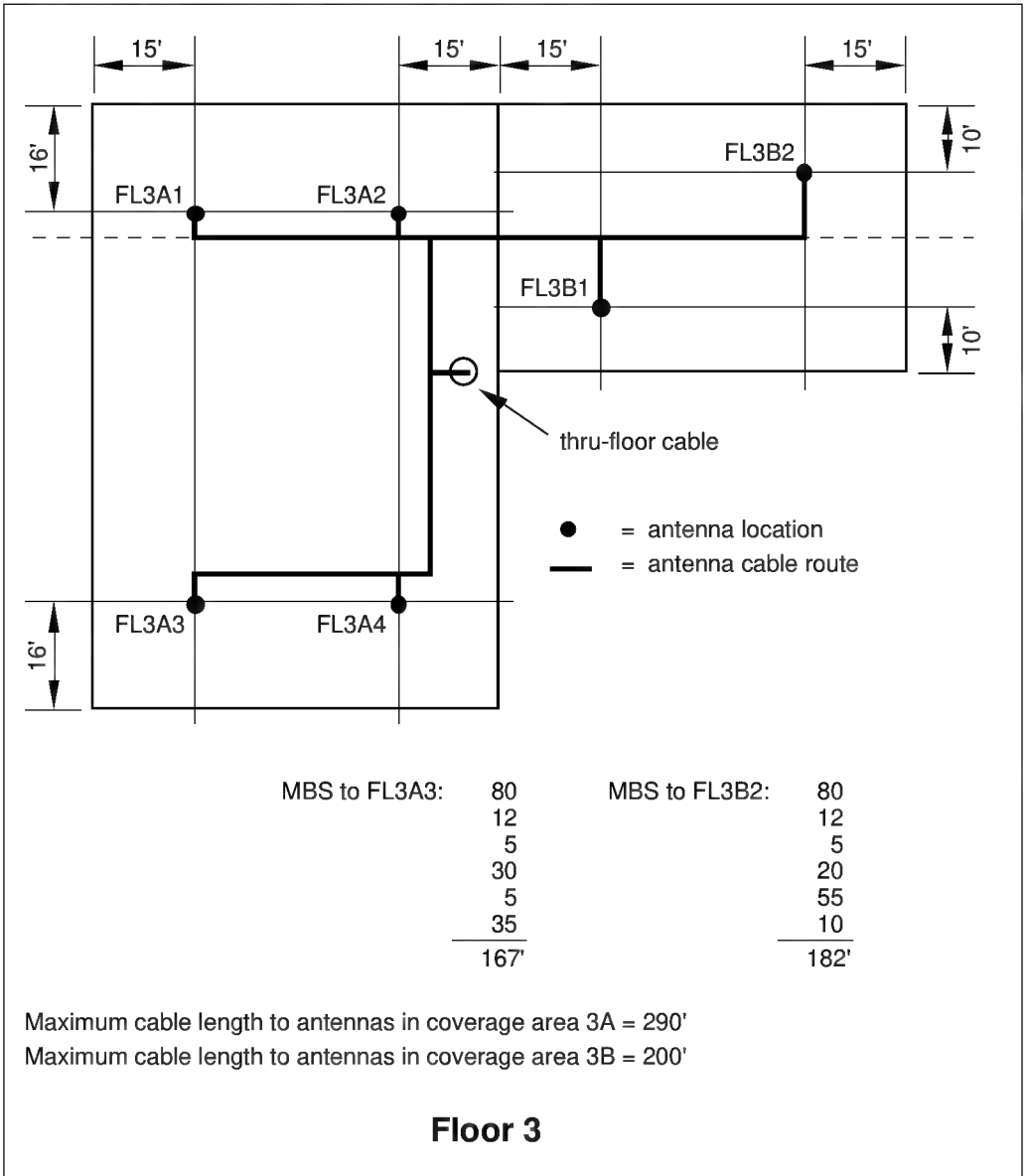


Figure 33
Cable length estimate for example job - third floor



The cable from the MBS to antenna FL3B2 is more than 80% of the maximum. In this case, it would be wise to double-check the estimate, perhaps perform a measurement of the cable run before committing to a price.

MBS and hybrid placement

Using the adjusted preliminary design as a starting point, mark the MBS locations on the floor plans. Sketch the room layouts to ensure that enough space is available for all MBSs and hybrids. Try to position each MBS to minimize the length of RF cable run between the MBS and the hybrid or hybrids, if any, and between the hybrids and any preinstalled cable protection plant you intend to use. Only 6 ft of RF cable is available for each port at the back of the MBS to connect to a hybrid, as Figure 34 shows. Note that the length of the MBS power cord is 6.58 ft.

The MBS comes in standard floor mount, seismic floor mount, wall mount, and rack mount versions. For floor-mount clearance requirements, refer to Figure 35. For wall-mount clearance requirements, refer to Figure 36. Figure 37 shows hybrid placement for two floor-mounted MBSs. For rack-mount clearance, be sure that there is enough room left behind the MBS for hybrid placement and for installation and maintenance access.

For more information about mounting MBSs and positioning hybrids, see the *Nortel COMPANION Microcellular Installation guide* (553-3611-200).

Figure 34
MBS power cord and cable length

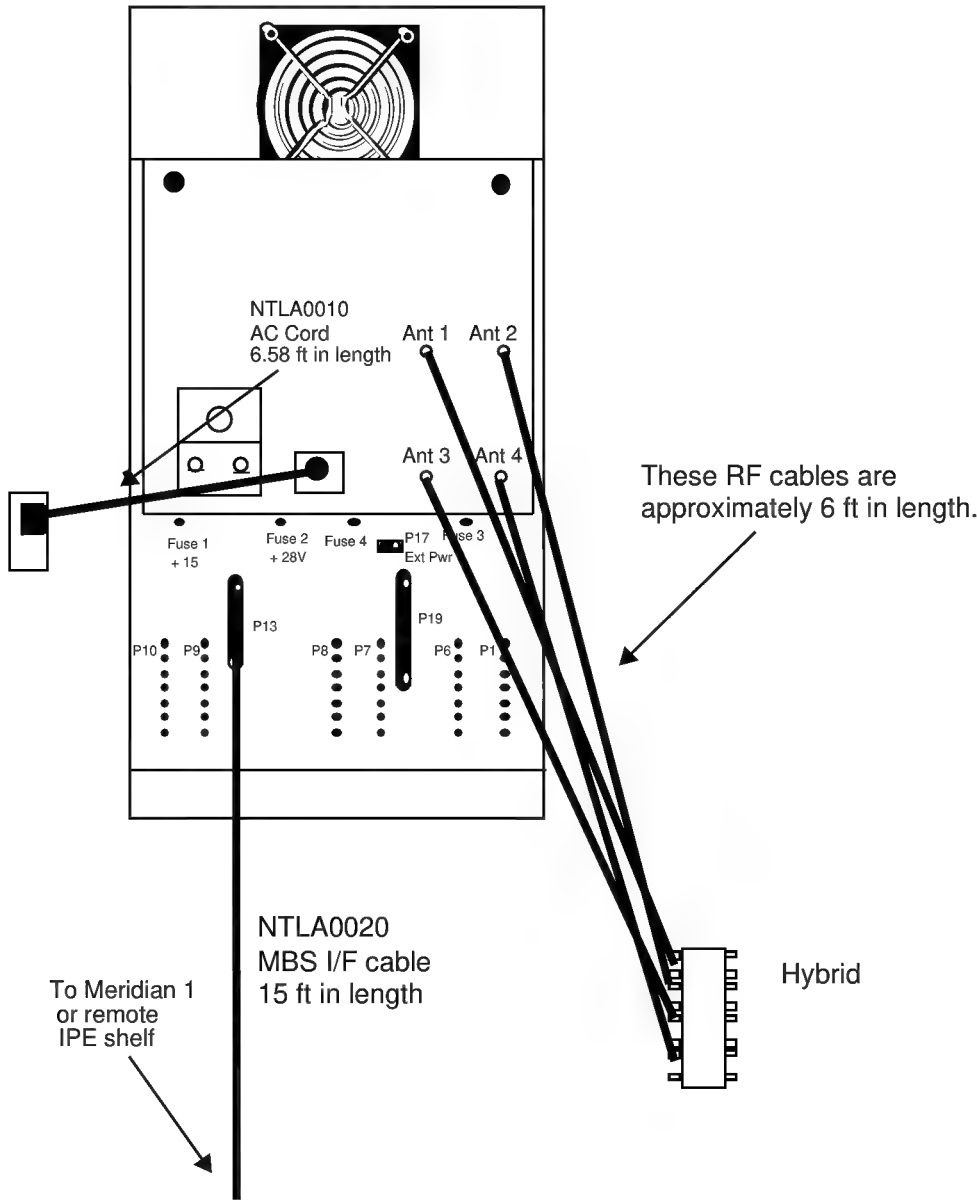


Figure 35
Floor mount MBS Installation requirements

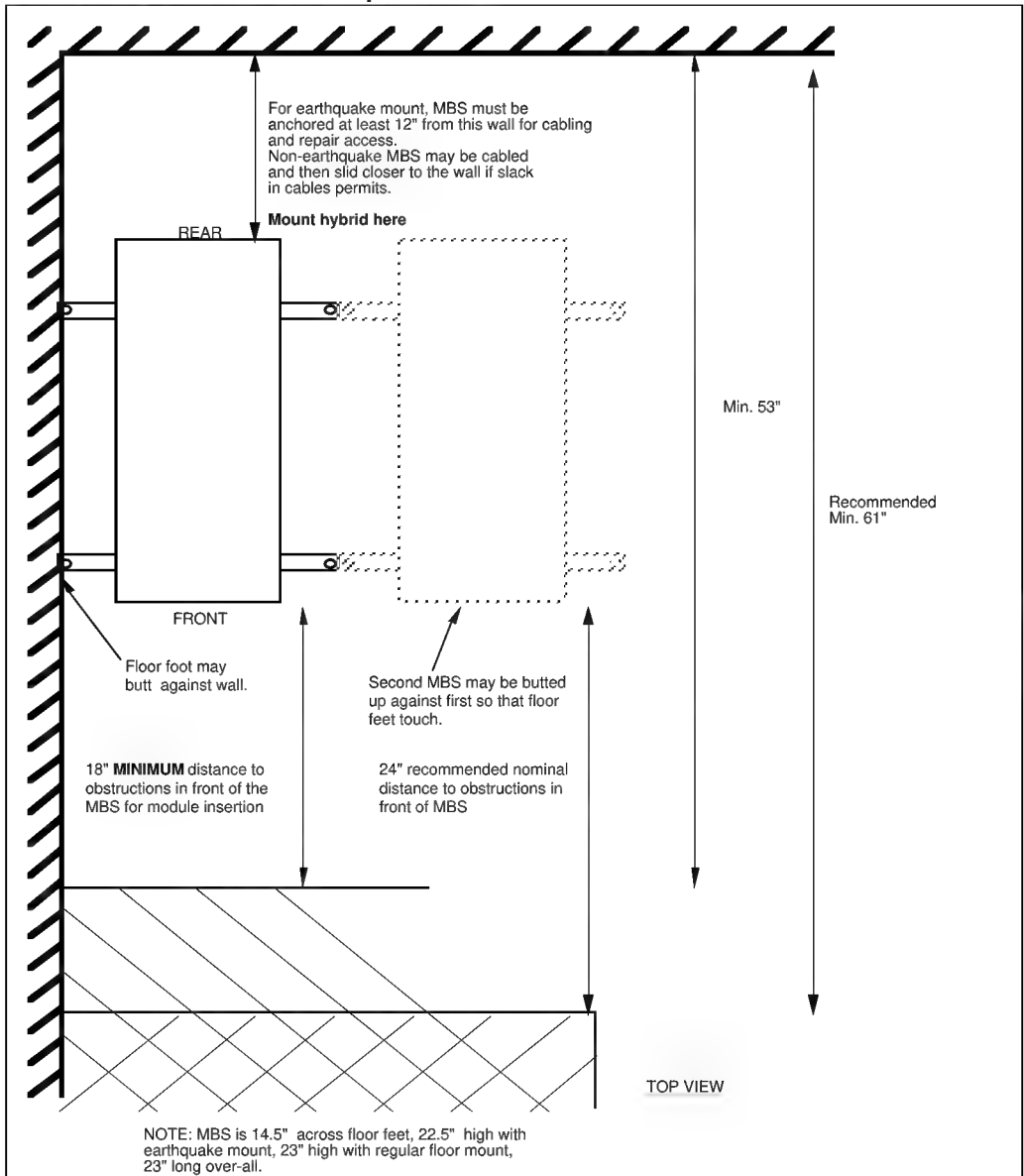


Figure 36
Wall mount MBS installation requirements

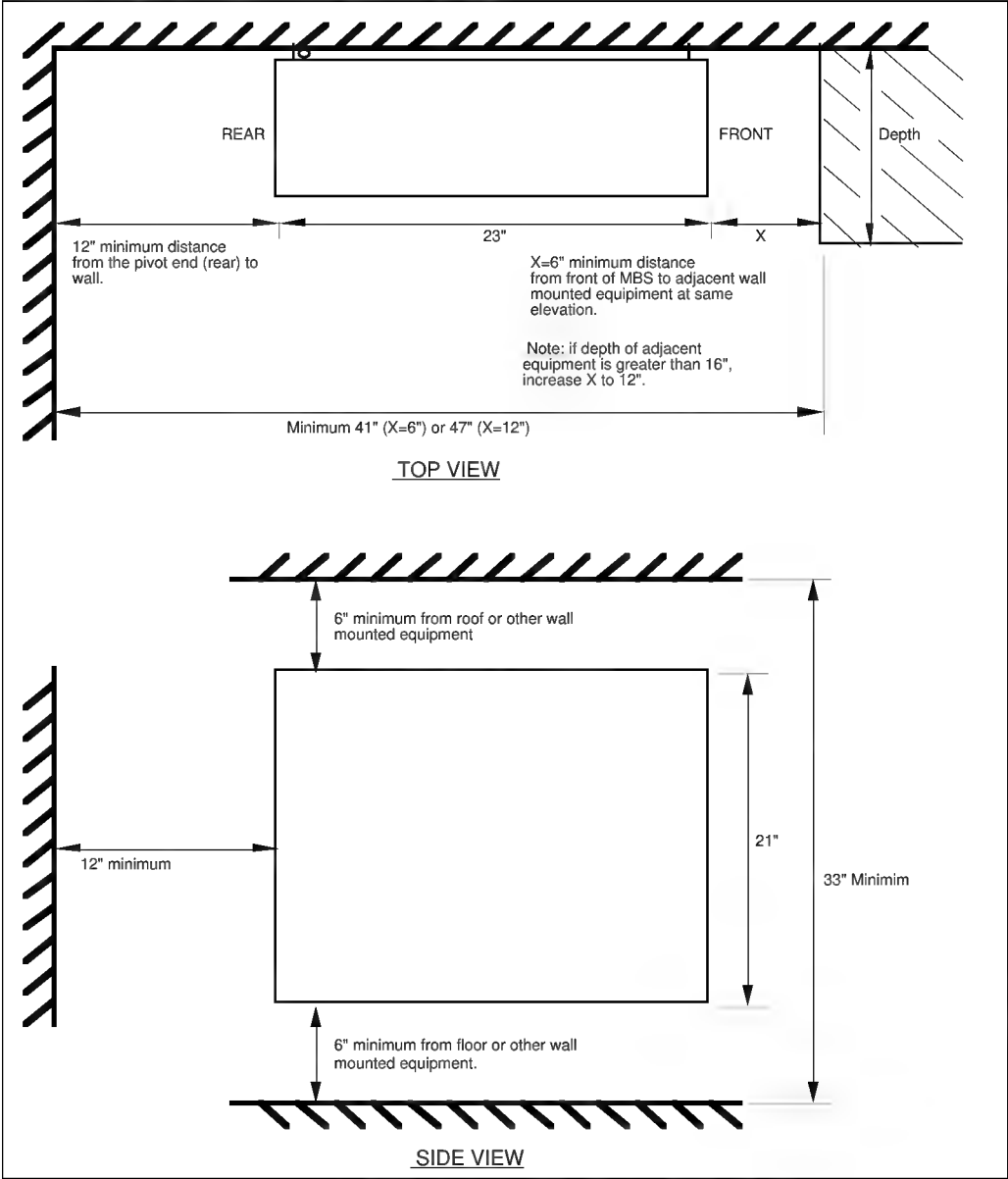


Figure 36
Wall mount MBS installation requirements (continued)

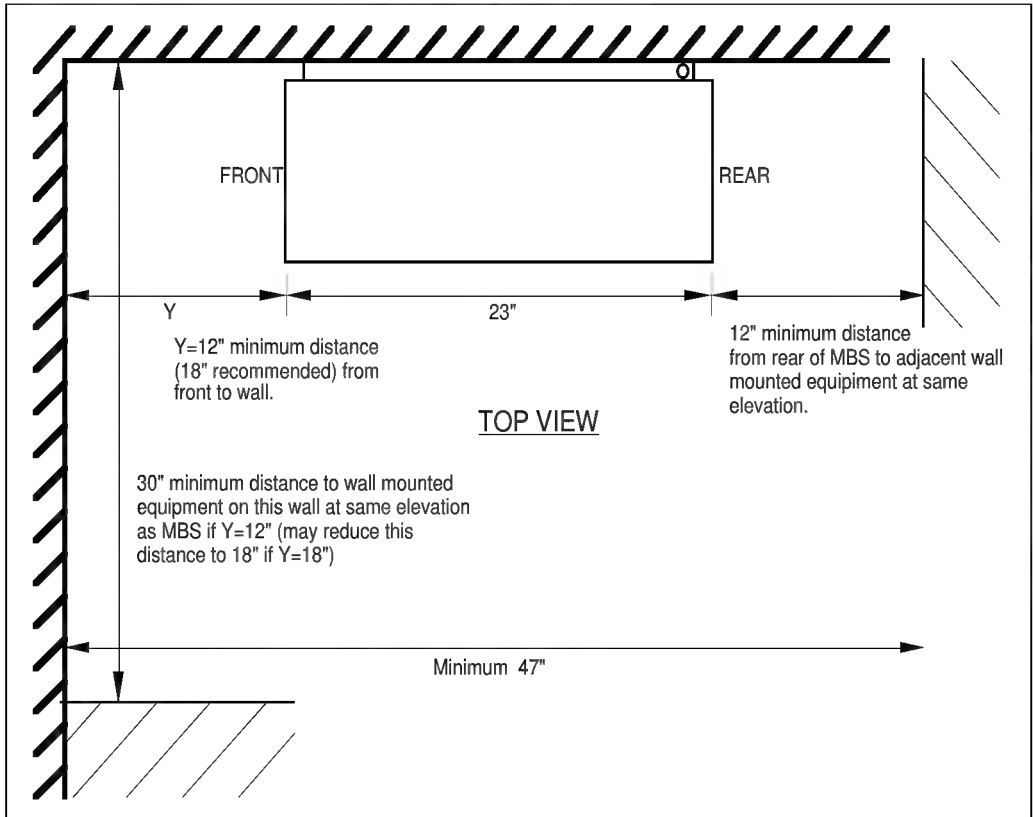
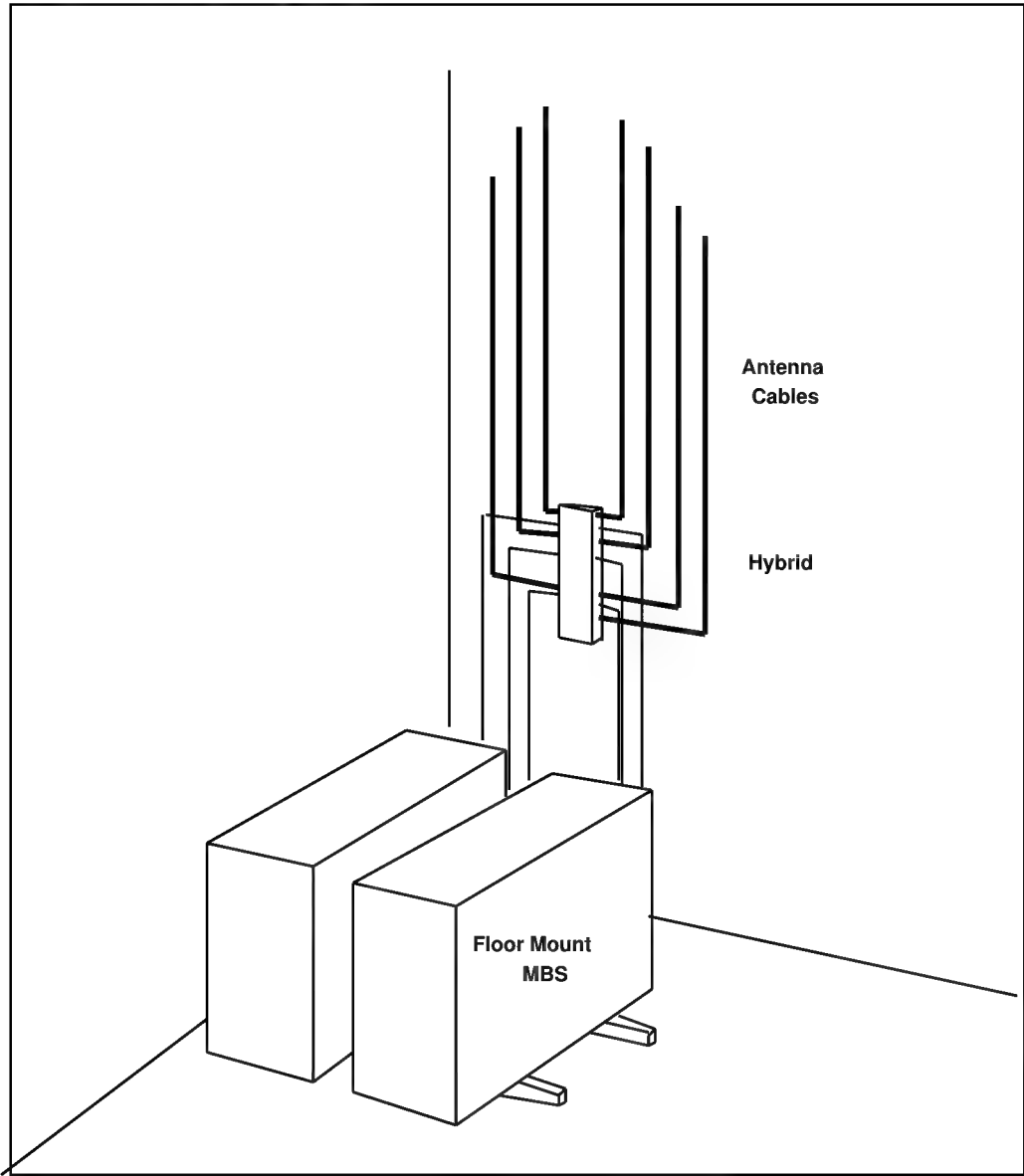


Figure 37
MBS floor mount with hybrid



TCM wiring

If cross-connect equipment is not available at the site to connect the MBSs to a Meridian 1 system, the equipment must be ordered and installed. Each Meridian 1 uses up to 50 leads, and each MBS uses up to 8 leads. Interconnect cables on both units are connected with a 50-pin AMP connector if the site uses distribution frames; Table 7 lists these connections.

The Meridian 1 and the MBS are not plug compatible, even if mounted side-by-side. You need to design some sort of interconnect system. Nortel recommends removing and pushing down the Amp connector to use just the last four TCM pairs.

Table 7

Suggested MBS TCM and Meridian 1 MXC port connections

MBS connector (P13, back of MBS) pin number	Color code	Signal	Amp connector side P1	DF pin number	Meridian 1 MXC Port connection
IMPORTANT: Your cable color codes might differ. If you cut off the connector, you can use the colors on the connector as a reference.					
MBS 1					
22	R/B	TCM 0 Tip	47		1
10	B/R	TCM 0 Ring	22		26
23	R/O	TCM 1 Tip	48		2
11	O/R	TCM 1 Ring	23		27
24	R/G	TCM 2 Tip	49		3
12	G/R	TCM 2 Ring	24		28
25	R/Br	TCM 3 Tip	50		4
13	Br/R	TCM 3 Ring	25		29
MBS 2					
22	R/B	TCM 4 Tip	47		5
10	B/R	TCM 4 Ring	22		30
23	R/O	TCM 5 Tip	48		6
11	O/R	TCM 5 Ring	23		31
24	R/G	TCM 6 Tip	49		7
12	G/R	TCM 6 Ring	24		32
25	R/Br	TCM 7 Tip	50		8
13	Br/R	TCM 7 Ring	25		33

Connectivity

The number of antennas in a cell defines the number of hybrids. Traffic requirements define how many TRU-IIs a Microcellular system needs. The number of TRU-IIs determines the number of MBSs. The maximum is 4 MBSs per cell.

For tables in which you can record the MBS connections to hybrids and antennas, see "MBS to antenna tables" on page 143 (Appendix B).

AFP Station placement

The following guidelines apply to the deployment of AFP Stations:

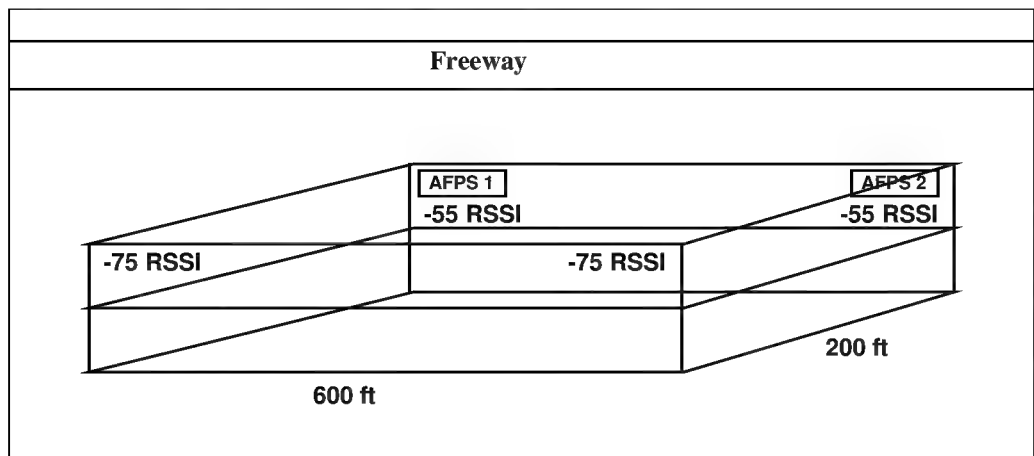
- A Microcellular system can have up to 12 AFP Stations (Option 11C, 51C, 61C, 81, or 81C)
- Each AFPS can cover approximately 100,000 square feet of floor space, based on the perimeter of one story the building
- Place AFP Stations at the highest points of the Microcellular site, but not higher than the 10th floor. For example, for a four-story building, place the AFP Stations in the ceiling of the 4th floor.
- Place multiple AFP Stations as far from each other as possible.
- Do not place an AFPS within 30 feet of a Microcellular antenna or near metal.
- Do not place an AFPS in an air plenum area of the ceiling.
- Do not place an AFPS more than 3,000 feet from the Meridian 1 system if you are using a TCM connection between the AFPS and the MSM MAT because the AFPS cannot be more than 3,000 feet from its DLC port. With a serial connection between an AFPS and the MSM MAT, the AFPS can be farther away from the Meridian 1 system.

To determine the placement of AFP Stations, you need the macrocell RSSI readings from the perimeter of the Microcellular site. For example, Figure 38 shows the macrocell RSSI readings and the placement of AFP Stations in a two-story building that is next to a freeway. The negative numbers at the corners of the building represent RSSI readings of the macrocell channels.

The Microcellular site requires two AFP Stations because the building has 120,000 sq ft of floor space. The side of the building that is closer to the freeway has more powerful readings, so the APF Stations should go on that

side to monitor the macrocell channels. Based on these readings and the deployment guidelines, placement of AFPS 1 is in the ceiling at one corner of the second floor, on the side nearest the freeway, and placement of AFPS 2 is high in the other corner on that side.

Figure 38
AFPS locations near stronger RSSI readings



Installation personnel have a choice when installing AFP Stations. They can use either direct serial connections between the MSM MAT and the AFP Stations or TCM connections that utilize the Meridian Communications Unit (MCU). Figure 4 on page 15 shows the MCU configuration. Figure 4 on page 15 shows the serial configuration.

For a site that deploys multiple AFP Stations, Nortel recommends the MCU configuration because the number of serial ports on the MAT is limited. For TCM connections, the installer needs up to 3,000 ft of TCM cable for the MCU and for each AFP station, an RS-232 modem pool cable (up to 50 ft) to connect the MCU to the MSM MAT, and either a local or remote power supply.

The Meridian 1 system needs to have a Digital Line Card (DLC) port available for the MCU and one DLC port for each AFP Station.

Nortel provides the following equipment for AFP Stations:

- An external antenna for each AFPS
- A local, plug-top power supply for each AFPS
- A Meridian Communications Unit with an RS-232 modem pool cable and local power supply

For a serial connection for an AFP station, the installer needs an RS-232 modem pool cable (up to 50 ft) from the MSM MAT to a short-haul modem as well as from another short-haul modem to the AFP station. To connect the modems, the installer needs telephone cable, which can be longer than the 3,000 ft limit for TCM cable. Each AFP Station needs a local or remote power supply.

The Remote Power Interconnect (RPI) unit, either an RPI8 or RPI16, can supply power remotely through TCM cables to AFP Stations.

Final equipment list

To provision the Microcellular equipment, follow the rules and guidelines under "Preliminary design and equipment list" on page 59. Follow the preceding detailed design instructions to refine the equipment list.

The equipment list should also include spare parts and Field Replaceable Units, which "Spare parts" on page 128 describes, and tools for installing antennas, which "Antenna installation tools" on page 129 describes.

Antenna systems

Provision the following equipment for the antenna system or systems:

- Total number of directional antennas for all the cells
- Total number of omni antennas for all the cells
- One solid ceiling mount or hidden ceiling mount kit for each antenna
- Total coaxial cable length for each size of cable you chose for the cells, including a cutting margin as well as an extra length to cover for possible installation errors
- One hybrid terminator for each active output port that does not connect to an antenna

To determine the number of antennas and mount kits, the amount of cable, and the number of hybrid terminators to provision, follow the instructions under "Preliminary design and equipment list" on page 59, "Microcell Deployment Data Collection (MDDC)" on page 91, "Antenna placement and cabling" on page 101, and "MBS and hybrid placement" on page 111.

Microcellular Base Stations

Provision the following equipment for the MBSs:

- Total number of MBSs for all the cells
- Total number of TRU-IIs for all the MBSs
- Total number of Dual 8-Port hybrids and Quad 4-Port hybrids
- One RF antenna cable for each MBS to hybrid connection
- One TNC 50-ohm terminator for each active MBS output port that does not connect to an antenna or hybrid
- One seismic floor mount, standard floor mount, or wall mount kit for each MBS or one rack mount kit for every two MBSs
- Any cross-connect equipment you need to connect the MBSs to the Meridian 1 system

To determine the total number of MBSs, TRU-IIs, RF Antenna Cables, and TNC terminators, follow the instructions under "Preliminary design and equipment list" on page 59, "Microcell Deployment Data Collection (MDDC)" on page 91, and "MBS and hybrid placement" on page 111.

To determine the amount of cross-connect equipment, see "TCM wiring" on page 117.

Automatic Frequency Planning (AFP) Stations

Provision the following equipment for the AFP Stations

- The AFP Station or Stations, with which Nortel provides the following equipment:
 - Local, plug-top power supply each AFPS
 - Meridian Communications Unit (MCU) and local, plug-top power supply for the MCU
 - RS-232 modem pool cable to connect the MCU to the local MSM MAT
- Local MAT with a CD-ROM (unless a local MAT with an Ethernet link to the Meridian 1 system already exists)

— For TCM connections, the following equipment:

- If the AFP Stations will not use local power supplies, a Remote Power Interconnect (RPI) unit, either RPI8 or RPI16, and TCM cable to connect the RPI to each AFPS.
- Meridian Communications Unit (MCU) and local power supply
- RS-232 modem pool cable to connect the MCU to the local MSM MAT
- TCM cable to connect the MCU to a DLC port on the Meridian 1 system and to connect each APF Station to a DLC port (up to 3,000 ft for each connection)

A DLC port is required on the Meridian 1 system for the MCU and for each AFP Station.

— For serial connections, the following equipment for each AFP Station:

- If the AFP Stations will not use local power supplies, a Remote Power Interconnect (RPI) unit, either RPI8 or RPI16, and TCM cable to connect the RPI to each AFPS.
- Two short-haul modems
- Two RS-232 modem pool cables to connect one modem to the local MSM MAT and the other modem to the AFP Station
- Telephone cable to connect the modems

A serial port is required on the local MSM MAT for each AFP Station.

To determine how many AFP Stations to provision, follow the instructions under "Automatic Frequency Planning (AFP) Stations" on page 73.

Meridian 1 Microcellular Cards

Provision the following Microcellular cards for the Meridian 1 system:

- One EIMC per Microcellular zone
- One MXC for a control-channel TRU-II and up to three traffic-channel TRU-IIs for ACELP/VSELP, or one MXC for a control-channel TRU-II and up to seven traffic-channel for VSELP

An EIMC supports a maximum of maximum of 15 MXCs. A Microcellular system supports a maximum of 15 MXCs per IPE shelf. For a VSELP-only system, up to 12 MXCs per superloop may be configured.

For one control channel and 15 traffic channels in a VSELP-only configuration, you need three MXCs: the first MXC for the control channel and 7 traffic channels, the second MXC for 7 more traffic channels, and the third MXC for 1 traffic channel. You can also use the third MXC for a control channel and 6 traffic channels in another cell.

- One MISP for an Option 51C, 61C, 81, or 81C system (cannot be shared with ISDN)

Portable telephones

If the Customer Information Form (Appendix A) indicates the number of portable users for the Microcellular system, provision one portable telephone for each user. Nortel has tested the NOKIA 2160. You can use other portables that conform to the IS-136 or IS-54B (dual-mode AMPS data, TDMA-3 voice) radio protocols, but operation of other portables might vary, depending on each portable's feature set.

Spare parts

Spares and Field Replaceable Units for the Microcellular system are not usually stocked on site. Instead, the service people probably carry a small stock of "known good" components in their service vehicle for troubleshooting swap-out and repair, replenished from a central repair depot. For a list of spare parts and Field Replaceable Units, see Table 4 on page 81.

Antenna installation tools

Using purpose-designed gauges and tools for attaching connectors to cables improves the performance of the antenna-system connectors. You can order the tools to use with cables from Andrew Corporation (Customer Service Center—1-800-255-1479):

- Pin Alignment Tool, Andrew part #224360
- Pin Depth Gauge, Andrew part no. #224380
- Pin Soldering Pliers, Andrew part #224377

Deployment plan and configuration

The detailed design report provides a final deployment plan and configuration for the customer and for the Microcellular system installer. The system administrator also needs the final design documentation for future maintenance. Your design report needs to include the following documents:

- Floor plans for the site, complete with antenna locations, cable routing and location tolerances, AFPS locations, and sketches of the MBS and Meridian 1 locations
- An antenna system connectivity chart or charts (see Appendix B)
- Connectivity diagrams or charts showing the TCM connections between the MBSs in each cell and the Meridian 1 system
- Placement of the modem and phone line for the CMCP connection
- Placement of Microcellular cards in the Meridian 1 system
- Any user information you have about the features requested for portables, and for Multi-Site Networking, the location of each user
- The control channels and frequencies provided by the cellular operator
- An equipment list for provisioning the Microcellular hardware, cables, cards, and installation supplies

Appendix A: Customer Information Form

The following pages contain the customer questionnaire for a proposed Microcellular system. The sales representative or sales support engineer can help the customer fill out this form and return it to the Meridian 1 distributor. The site planning engineer uses information from the questionnaire to produce a preliminary design and quote for the customer, as “Preliminary design overview” on page 35 describes.

Companion Microcellular - Customer Information Form (CIF)

Please provide the following information for your customers site. This information will be used to generate a Companion Microcellular equipment list and pricing for your customer and by the cellular carrier to identify Radio Frequency (RF) requirements.

Meridian 1 Distributor Contact:					
Distributor Name:			Cellular Company:		
Rep Name:			Rep Name:		
Address			Address		
City:	State:	Zip:	City:	State:	Zip:
Phone:		Fax:	Phone:		Fax:

Customer Information (Actual Site Location)			
Name:			Address:
City:	State:	Zip:	
Phone:			Fax:
Contact Name:			PBX Vintage and Software Version:

Site Profile - Continuum

Please mark an "X" along the shaded line to note how this application fits the following 7 criteria.

1. Cellular Operator Coverage

YES

NOT SURE

NONE

2. Traffic Density

Low Density

Suburban
Campus

Downtown

3. Physical Building

One Building - One Floor

3 Buildings
4 Floors
Some Outside
Areas

6-10 Floors
Building with
More Than 10
Floors

4. Senior Executive committed to investing in new technology

YES

NOT SURE

NO

5. Application: Describe Mission Critical

Unknown
Application

6. Estimated Number of Users for Companion Microcell

1500+

800

100

50

25

10

7. Price Sensitivity

\$3000/User

\$2000/User

\$1500/User

\$1000/User

\$400/User

Physical Description

Describe the physical location of the planned Microcellular Coverage area For example: XYZ Company campus is 4 acres on the corner of LBJ Freeway and Main Street. They occupy two 5-story buildings. They need coverage within the buildings and in the area around the buildings.

Description (including exact site address):

Campus? [] How Many Buildings? []
Number of floors above ground that require coverage:

Downtown [] Suburban [] Rural []

Description:

What is the square footage of each building? 1. [] 2. []
3. []
How Many users in each building? 1. [] 2. []
3. []

Outside Coverage Required? []

Number of floors below ground:

Customer Benefits/Application Description

How will microcell improve your customer's productivity? (Be as specific as possible and quantify with the number of users and the amount of gain.) *For example: XYZ Company has 100 people in the manufacturing facility who could save two hours of productive time each day by having reliable wireless communication within the plant.*

How will microcellular mobility save this customer money? (Be specific and quantify number of users and amount of savings.) *For example: XYZ Company can save the cost of 50 new desksets by adding wireless users directly to the PBX dialing pattern and feature sets. Each deskset model 12345 costs XYZ Company \$900.00 plus a maintenance fee.*

Current Cellular Use

If the customer currently has a corporate cellular service contract, please provide the following information:

	How many users?	How many will also use the Microcellular product?
	Estimate the total number of Minutes of Use per month on the Microcell:	
	How many users of each type of portable AMPS(Analog)? [] Dual Mode Digital(AMPS/TDMA)?[]	
	Cellular Service Company: Name: Phone: Fax:	
Cellular Regional Microcellular RF Manager:		Phone:

Meridian 1 Information

Please provide the following information for each Meridian 1 system or Remote IPE installation that will be served by Companion Microcellular. If there are multiple Meridian 1 systems in the customers operation, will the “Multi - Site Networking” feature be used?

Yes [] No [] If yes please indicate which M1 systems will be involved.

	Location (City & State)	Location (Building)	M1 Option	X11 Release	Number of Companion Microcellular Users	
					Initial	Future (Specify Timeframe)
M1 No. 1						
M1 No. 2						
M1 No. 3						
Remote IPE No. 1						
Remote IPE No. 2						

Preliminary RF Design

Please provide a set of scaled floor plans for each building that will house users of this product. Please indicate the following on each floor plan:

	Areas where coverage will be required:
	Any known/planned major changes to existing exterior dimensions or interior partitions:
	Location of Meridian 1 systems and Remote IPEs:
	Do any of the building(s) ever experience power outages or wide swings in power? Yes ☐ No ☐ If yes, please indicate which buildings.
	Areas that currently experience poor cellular coverage:
	Coaxial cable (0.5") is required between the Microcellular Base Station(s) and the antennas.
	Are there any restrictions on where the antennas can be placed? If so, please be as specific as possible.
	Preferred location of Microcellular Base Stations. (Base Stations can be wall mounted or free standing. They measure about 10" W x 20" H x 22" D and weigh about 90 lbs when fully equipped.

Design Process

Please complete the following with Name, Initials and Date, # OF DCCH, and voice channels WHERE needed.

<i>Activity</i>	<i>Owner</i>	<i>Name</i>	<i>Initials</i>	<i>Date</i>	<i># of Cells</i>	<i># of Channels</i>	<i>OK</i>
Complete Site Survey	Nortel Distributor				NA	NA	
Pre Qualification	Nortel Account Manager				NA	NA	
Initial Site Acceptance	Cellular Operator Sales Manager				NA	NA	
Preliminary RF Design	Nortel RF Services						
Spectrum Availability	Cellular Regional RF Engineer						
Final RF Design	Nortel						
Final System Proposal	Cellular Director of Engineering						

Complete this form and then please FAX to:	Please return this 'completed form' & 'scaled floor plans' to:
Nortel Attn.: Arne Lepp FAX: 905-863-8452 Please call Arne Lepp (905-863-1770) to confirm receipt of this form.	Nortel 2435 North Central Expressway, 5th Floor Richardson, TX 75080 Attn.: David Jefferys FAX: 972-685-3111

**THANK YOU FOR YOUR INTEREST IN
COMPANION MICROCELLULAR**

Appendix B: MBS to antenna tables

MBS #1	
Antenna port	To hybrid
1	
2	
3	
4	

MBS #2	
Antenna port	To hybrid
1	
2	
3	
4	

MBS #3	
Antenna port	To hybrid
1	
2	
3	
4	

MBS #4	
Antenna port	To hybrid
1	
2	
3	
4	

Hybrid #1			
From MBS	Input port	Output port	To antenna
	IN 1	OUT 1	
	IN 2	OUT 2	
	IN 3	OUT 3	
	IN 4	OUT 4	
	IN 5	OUT 5	
	IN 6	OUT 6	
	IN 7	OUT 7	
	IN 8	OUT 8	

Hybrid #2			
From MBS	Input port	Output port	To antenna
	IN 1	OUT 1	
	IN 2	OUT 2	
	IN 3	OUT 3	
	IN 4	OUT 4	
	IN 5	OUT 5	
	IN 6	OUT 6	
	IN 7	OUT 7	
	IN 8	OUT 8	

List of terms

ACELP

Algebraic Code Excited Linear Predictive, a method of implementing EFRC (Enhanced Full Rate Codec) in TDMA systems for improved digital voice quality. TDMA-3 ACELP implements the IS-641 protocol in IS-136 systems. A Microcellular system can support both ACELP and VSELP users. See also *IS-136*, *IS-641*, and *VSELP*.

AFP

See Automatic Frequency Planning.

AFP region

A Microcellular system component that is the parent of one or more AFP Stations.

AFPS

See Automatic Frequency Planning Station.

AMO

Antenna Matrix/Oscillator.

antenna matrix (4 x 4)

The elements internal to the MBS that allow all 4 internal TRU-IIs to be connected to all 4 antenna ports.

antenna structure

The antenna elements, external to the MBS, including the antennas, cables, and hybrids (splitters/combiners).

APS

Alarm and Power Supply Module, part of the MBS assembly.

Automatic Frequency Planning (AFP)

A feature of the Microcellular system that automates the assignment and adjustment of microcell operating frequencies so that they do not interfere with the macrocellular system.

Automatic Frequency Planning Station (AFPS)

A scanner/receiver connected to the Meridian 1 system that measures forward and reverse RSSI on specified channels, extracts information from macrocell channels, and returns the Bit Error Rate on specified Microcellular control channels. The AFPS helps the cellular operator determine what channels are available for the Microcellular system to use.

Base Station

See Microcellular Base Station.

CAI

See Common Air Interface.

cell

The portion of a zone, or radio coverage area, served by a control-channel radio and from one to 15 traffic radios. A cell is also called a partition. Cell sizes vary with layout and building architecture. Portables use only one Common Air Interface (CAI) radio protocol within a cell; if both IS-136 and IS-54B portables operate in the same cell, all of them use the IS-54B protocol.

cell boundary value

A signal strength value specified as the minimum acceptable level for radio coverage by a specific Microcellular Base Station. During site planning this value is used to locate the outer edge of the coverage area for each cell.

cellco

See cellular company.

Cellco Mobility Control Point

See CMCP.

cellular

Mobility systems using radio techniques that provide wide coverage by splitting regions into cells and having adjacent cells use different frequencies. Includes both macrocellular and microcellular systems.

cellular company

A cellular (operating) company holds a license to operate and control cellular equipment within a certain geographical region, using a defined range of frequencies. The cellular company must provide the frequencies that the Microcellular system uses. Operation of the Microcellular system continues only if a link is maintained between the Microcellular system and the CMCP. The cellular company can change the frequency allocation at any time.

cellular service provider

See *cellular company*.

CMCP

Cellco Mobility Control Point. A MAT-based application that provides the cellular company with control over the use of frequencies by the Microcellular systems within its licensed region. Communicates with the MNCP (Meridian 1 Network Control Point) through a modem (PPP) connection.

co-channel interference

Interference between two channels of the same frequency.

Common Air Interface (CAI)

A uniform set of radio protocols. See also *IS-54B*, *IS-136*, and *IS-641*.

Core

See *Meridian 1 Core software*.

coverage area

The zone in which a portable telephone user should be able to make and receive calls. It can include stairwells, elevators, and so on.

DF

Distribution Frame.

distributed antenna system

A collection of antennas located throughout a cell.

DLC

Digital Line Card, a Meridian 1 card that gives the AFP software on the local MSM MAT access to AFP Stations as if they were Meridian 1 sets.

downlink

The signal path for MBS to portable communication, in a forward channel.

Dual 8-Port Hybrid

The Dual 8-Port Hybrid is a combiner/splitter with MBS-to-hybrid input ports and hybrid-to-antenna output ports on both sides. See also *Quad 4-Port Hybrid*.

EFRC

Enhanced Full Rate Codec. See also *ACELP* and *IS-641*.

Embedded Intelligent Mobility Controller (EIMC)

The EIMC, an IPE circuit card, is the Microcellular system's wireless controller. This hardware pack is responsible for Layer 2 and Layer 3 processing as well as handoffs between different Microcellular Base Stations.

ESN

Electronic Serial Number/Electronic Switched Network. Each portable in a Microcellular system has an ESN that the system uses to locate the portable. A wireline set can share an ESN with a portable. See also *MIN*.

FCC

Federal Communications Commission. A board of commissioners to regulate all interstate (but not intrastate) and foreign electrical telecommunications systems that originate in the United States.

forward channel

A forward channel in a cell is for MBS to portable communications, using a downlink.

handoff

A feature within wireless systems that allows portables to be moved about while continuing to receive uninterrupted service. The system moves a call from one traffic channel to another, either within the same cell, to improve reception ("interference handoff"), or to the traffic channel of another cell, to allow mobility ("mobility handoff"). Also called "handover."

hardware

Physical devices and circuit packs, including the processors that run software.

heartbeat

Periodic signal between the CMCP and the Microcellular system.

hybrid

A combiner/splitter with MBS-to-hybrid input ports and hybrid-to-antenna output ports. See also *Dual 8-Port Hybrid* and *Quad 4-Port Hybrid*.

interzone handoff

A handoff that occurs between cells of two different zones. See also *handoff*.

Intrazone handoff

A handoff that occurs from one cell to another cell within the same zone. See also *handoff*.

IPE

Intelligent peripheral equipment. Microcellular cards are installed on an IPE shelf in a Meridian 1 system.

IS-54B

Cellular System Dual-Mode Mobile Station—Base Station Compatibility Standard. IS-54B is a Common Air Interface (CAI) radio protocol that defines the interface for TDMA-3 and AMPS, with an analog control channel.

IS-136

Cellular System Dual-Mode Mobile Station—Base Station Compatibility Standard. IS-136 is a Common Air Interface (CAI) radio protocol that defines the interface for TDMA-3/VSELP and AMPS or TDMA-3/ACELP and AMPS, with either an analog control channel or a digital control channel. See also *ACELP* and *VSELP*.

IS-641

Cellular System Dual-Mode Mobile Station—Base Station Compatibility Standard. IS-641 is a Common Air Interface (CAI) radio protocol that defines the TDMA-3 ACELP implementation to incorporate EFRC into IS-136 systems. See also *ACELP*, *EFRC*, and *IS-136*.

ISDN

Integrated Services Digital Network. Switched digital network providing telephone company signaling information and user voice and data services over the same digital transmission and switching facilities.

MAT

Meridian Administration Tool. A MAT running Mobility System Management (MSM) is required for installation, operation, administration, and maintenance of the Microcellular system. A local MSM MAT connects to a Meridian 1 system through Ethernet, and a remote distributor MSM MAT can also connect to the Meridian 1 system. The CMCP application runs on a MAT. See also *Automatic Frequency Planning* and *Mobility System Management*.

MBS

See *Microcellular Base Station*.

MCU

Meridian Communications Unit, which gives the AFP application, running on the local MSM MAT, access to AFP Stations as if they were Meridian 1 handsets.

Meridian 1 C-Series

Meridian 1 Option 11C, 51C, 61C, 81, and 81C systems.

Meridian 1 Core software

The software components that reside on the CPU card, including the existing Meridian 1 software (Core Features) and the Mobility Service Provider (MSP), the Core MSP, the Core Mobility Set Model, Core Mobility Switching, the MISP Interface Handler, and the Object Request Broker.

microcell

Cells and cellular systems using low-power base stations with smaller cell sizes, in either public or private domains. A cellular operating company must provide the frequencies that these systems use.

Microcellular Base Station (MBS)

The fixed part of a Microcellular system that is used to communicate with portable telephones using a radio interface. An MBS in a Microcellular

system supports up to 4 TRU-IIs, each of which can independently operate as a control-channel radio or a traffic-channel radio (dual-mode TDMA-3 voice/AMPS data).

Microcellular Transcoder Card (MXC)

The MXC provides transcoding of voice within the Microcellular system and can support ACELP/VSELP voice coding or VSELP voice coding. See also *ACELP* and *VSELP*.

MIN

Mobile Identification Number. An MIN together with an ESN identifies each portable in a Microcellular system. See also *ESN*.

MISP

See *Multipurpose ISDN Signaling Processor*.

mobile station

A part of a cellular system that you can use while in motion, such as a portable handset or headset.

Mobility System Management (MSM)

An application that runs on a MAT for installation, operations, administration, and maintenance of a Microcellular system.

Multipurpose ISDN Signaling Processor (MISP)

A Meridian 1 card, on an Option 51C, 61C, 81, or 81C system, that provides a communications interface between the Core Processor and peripheral devices. An MISP supplies routing and message relay between the Meridian 1 Call Processor (CP) card and to up to 8 EIMCs.

MXC

See *Microcellular Transcoder Card*.

NT

Northern Telecom.

NTP

Northern Telecom Publications; Meridian 1 and DMS system documentation.

partition

See *cell*.

PBX

Private Branch Exchange. A telephone system, owned by and installed on the premises of a business customer for use with an attendant console.

PC

Personal computer.

portable

Any Microcellular wireless set (portable telephone). A portable is the equivalent of an IS-136 or IS-54B “mobile station.”

The Microcellular system is designed for class 3 and 4 portables, which have a power output of 600 mwatts. (Class 1 portables, used as car phones, have a power output of 3 watts. Class 2 portables have a power output of 1.2 watts.

PPP

Point-to-Point protocol.

PRI

(ISDN) Primary Rate Interface having 23B + D format. Its digital trunk interface is at 1.5 Mbps.

primary surge protector

A voltage surge protector connected between each line conductor and ground located where telecommunications conductors enter a building structure. See also *supplemental power surge protector*.

PSTN

Public Switched Telephone Network. Consists of a location for customer equipment, a local loop, a local exchange area, interexchange transmission media, and a network switching area.

Quad 4-Port Hybrid

The Quad 4-Port Hybrid is a combiner/splitter with four MBS-to-hybrid input ports on one side and four hybrid-to-antenna output ports on the other side. See also *Dual 8-Port Hybrid*.

radio

See *TRU-II*.

Radio Line Card

See *Microcellular Transcoder Card*.

registration

The process in which a mobile station (portable) informs the system of its presence in a cell and requests permission to use the system's services. Includes both initial registration (upon entering a cell) and location registration (when moving between cells).

reverse channel

A reverse channel in a cell is for portable to MBS communications, using an uplink.

RF

Radio frequency, a frequency of the electromagnetic spectrum normally associated with radio wave propagation, usually above 150 kHz.

roaming

The ability of Microcellular system subscribers to be served by systems outside of their home system while still having many of the same capabilities that they would have in their home system (as opposed to call delivery, which refers to terminating a call to the subscriber regardless of location).

RPI

Remote Power Interconnect Unit, either RPI8 or RPI16.

RSSI

Received Signal Strength Indicator.

secondary power surge protector

See *supplemental power surge protector*.

SID

System identifier, a numeric or alphanumeric SID identifies the Meridian 1 system that includes the Microcellular system.

site planning

The process of positioning the Microcellular Base Stations, antennas, and other hardware in the system to maximize coverage for the portable telephones and minimize the number of Microcellular Base Stations required for acceptable performance. For detailed information on site planning, see the *Nortel COMPANION Microcellular Site planning and deployment guide* (553-3611-105).

supplemental power surge protector

A series-connected overcurrent protector, with optional voltage surge protection, located between a primary protector and the equipment. See also *primary power surge protector*.

TCM

Time Compression Multiplexing, which combines two or more information channels into a single transmission channel by assigning each information channel an exclusive, but short, periodic-transmission time interval.

TCM cable

Single twisted pairs of wires that provide a loop interface between an MBS, AFP Station, or MCU and a Meridian 1 system.

TDMA

Time Division Multiple Access. Used for through-the-air transmission used by cellular telephone systems.

TDMA-3

Uses TDMA Digital Traffic Channels with paired timeslots to provide three full rate traffic channels per pair of transmit/receive RF channels (for example, 13 kb/s user data, 16.2 kb/s gross, in each direction).

transcoder

A device that converts between two different coding schemes. See also *Microcellular Transcoder Card*.

TRU-II

Transmit Receive Unit II, a radio in a Microcellular Base Station. A TRU-II provides both the Tx and Rx RF channels for a single duplex link (control channel or traffic channel). Two Rx paths provide antenna diversity.

uplink

The signal path for portable to MBS communications, in a reverse channel.

version number

See *system version*.

VSELP

Vector Sum Excited Linear Predictive, a method of TDMA-3 voice coding implemented in the IS-136 protocol. See also *ACELP* and *IS-136*.

wireline set

Any telephone set whose operation requires a physical connection from the set.

zone

A group of cells that a single EIMC controls, including the geographical area that the cells cover.

zone controller

The EIMC that controls a zone.

Index

A

AC power surge protector, 61

accessories for antenna deployment, 90

ACELP

definition, 147

EFRC implementation, 1

IS-651 implementation, 1

maximum calls, 19

MXC services, 19

See also EFRC.

TCM loops from MXC, 19

adjacent channel interference, 8

AFP

See Automatic Frequency Planning.

AFP region

definition, 147

Microcellular system component, 14

AFP Station

coverage, 121

deployment guidelines, 121

description, 27

DLC port for TCM connection, 27

engineering rules, 121

functions, 27

hardware, 80

maximum number, 121

Microcellular system component, 13

minimum number, 27

MSM MAT control, 28

placement, 121, 122

quantity, 122

serial connection to MSM MAT, 27, 122, 123

TCM connection to MSM MAT, 27

AFPS

See AFP Station.

Algebraic Code Excited Linear Predictive

See ACELP.

AMO

Antenna Matrix/Oscillator, 81

definition, 147

Field Replaceable Component, 81

AMPS data, 20, 31

antenna

adjustment, 99

cable length

diagram, 108, 109

estimated, 106

cabling, 101

configured with TRU-IIs, 23

coverage gaps, 105

deployment tool, 90

directional, 90

distributed structure, 10

drawing conventions (diagram), 102

elevator shaft placement, 105

estimating number of, 65

installation tools, 129

locations, sample (diagram), 104

omni, 90

placement, 101

positioning requirements (diagram), 103

simulation, 43

antenna array

IMCS simulation, 65

Microcellular system component, 13

no hybrid, 65

- one hybrid, 66
- two hybrids, 67
- antenna configuration (diagram)
 - 1-4 antennas, 66
 - 5-8 antennas, 67
 - 9-16 antennas, 68
- antenna matrix
 - definition, 147
 - TRU-II access to ports, 20
- antenna simulation
 - analyzing results, 57
 - antenna information (diagram), 52
 - antenna type, 51
 - preparing to run, 44
 - simulation grid, 51
- antenna structure
 - definition, 147
 - distributed, 10
- antenna system
 - distributed, 23, 125
 - hardware, 79
 - tools for deployment, 89
- antenna tables, 143, 144, 145, 146
- APS
 - definition, 147
 - Field Replaceable Component, 81
- Automatic Frequency Planning, 27
 - cellular operator maintenance, 27
 - CMCP control, 30
 - definition, 148
 - description, 7
 - Mobility System Management feature, 28
- Automatic Frequency Planning Station, 27
 - See AFP Station.

B

- Base Station
 - See MBS.
- battery status checking, 98
- BER, 27
- blocked calls cleared, 63
- blocking, 12

- blocking probability table, 63
- busy hour, 12

C

- cable
 - coaxial part numbers, 84
 - connectors for coaxial, 83
 - length, antenna, 106, 108
- cabling
 - antenna, 101
 - MBS to antenna, 143
- CAI
 - See Common Air Interface.
- cell
 - characteristics, 61
 - definition, 148
 - description, 6
 - engineering limits, 6
 - forward channel, 6
 - IS-136 radio frequency rules, 6
 - IS-54B radio frequency rules, 7
 - limits, 61
 - logical, 23
 - Microcellular system component, 14
 - physical, 23
 - radio protocol, 6
 - reverse channel, 6
- cell boundary value
 - definition, 148
 - measurement, 99
- cellco
 - See cellular company.
- Cellco Mobility Control Point
 - See CMCP.
- cellular
 - concepts, 1
 - definition, 148
 - frequencies, 7
 - Microcellular portable, 1
 - systems, 3, 4
- cellular company
 - channel control by CMCP, 30
 - definition, 149

- frequency management, 30
- Multi-Site Networking, 32
- cellular operator
 - AFP, 27
 - channel assignment, 7
 - frequency plan maintenance, 7
- cellular service provider
 - channel allocation, 3
 - definition, 149
 - design review, 2
- CMCP
 - AFP control, 30
 - connection to Meridian 1, 30
 - definition, 149
 - description, 30
 - frequency management, 30
 - heartbeat monitoring, 30
 - Microcellular component configuration, 30
 - Microcellular system component, 13
- coaxial cable
 - and connectors (table), 83
 - cable types and standards, 71
 - N-style male connector count, 72
 - part numbers (table), 84
- co-channel interference
 - definition, 149
 - description, 8
- combiner
 - See hybrid.
- Common Air Interface
 - definition, 149
 - radio protocols, 6, 18
 - standard, 4
- configuration plan, 131
- connectivity, 119
- connector
 - part numbers (tables), 84
 - sizes and types, 83
- control-channel interference
 - description, 8
 - measuring, 94
- Core
 - See Meridian 1 Core software.

- coverage area
 - AFP Station count, 73
 - building specifications, 44, 49
 - cell underlay, 4
 - definition, 149
 - description, 8
 - design verification, 99
 - IMCS results, 57
 - maximum cable length, 106
 - MDDC scanning, 98
 - obstructions, 43
 - RSSI levels, 45
 - signal strength, 48
- coverage gap, antenna, 105
- Coverage window, 46
- Customer Information Form, 2, 36, 49, 133

D

- definitions, 147
- deployment, 90
 - AFP Station guidelines, 121
 - antenna accessories, 90
 - introduction, 1
 - plan, 131
 - procedure
 - flowchart, 3
 - steps, 2
 - tools, 89
- Deployment Data Collection
 - main menu, 93
 - software, 91
- deployment plan, 131
- design documentation, 131
- design project, 92
- design report, 88
- design verification, 99
- detailed design
 - output, 88
 - overview, 87
- DF
 - definition, 149
 - pin number, 118
- Digital Line Card for TCM, 122

Digital Trunk Interface, 32
directional antenna, 23, 24, 90
distributed antenna structure, 10
distributed antenna system
 definition, 149
 description, 23
 diagram, 11

DLC
 definition, 149
 port for TCM connection, 27
 See Digital Line Card.

downlink
 definition, 150
 minimum RSSI, 6
 signal path, 6

Dual 8-Port Hybrid
 count per cell, 69
 definition, 150
 description, 26
 diagram, 26
 limits and characteristics, 69
 terminator count, 70

DVCC/DCC, 27

E

EFRC
 ACELP implementation, 1
 definition, 150

EIMC
 count, location per M1 system, 74
 definition, 150
 description, 18
 Microcellular system component, 13

elevator shaft antenna placement, 105

Embedded Intelligent Mobility Controller
 See EIMC.

engineering limits, cell, 6

engineering rules
 AFP Station, 121
 cell, 6

equipment for testing, setup, 92

equipment list, final, 125

equipment planning, 75

Erlang B tables, 13

ESN
 definition, 150
 secured by CMCP, 30

F

FCC, definition, 150

field replaceable components, 128

forward channel
 definition, 150
 MBS to portable, 6

frequency management, 30

frequency plan, 7, 27
 cellular operator, 7
 cellular operator maintenance, 27

frequency planning, 94

G

grade of service, 12

guidelines, AFP Station, 121

H

handoff
 definition, 150
 interzone, 18, 151
 intrazone, 18, 151
 switching calls, 17

hardware

 AFPS, 80
 antenna system, 79
 definition, 150
 location in Meridian 1, 74
 prerequisite M1, 75
 radio system, 79
 required for Microcellular systems, 75
 system requirements, 59

heartbeat

 CMCP monitoring, 30
 definition, 151

hybrid, 26

 definition, 151
 determine number needed, 119
 Microcellular system component, 13

placement, 111
requirement, 65

I

IMCS

antenna information, 51
antenna simulation, 43
color table (diagram), 55
Coverage window, 46
input parameters, 49
output, 45
Placement Configuration window, 47
simulation
 antenna, 43
 flowchart, 45
 preparation, 44
 results, 54, 57

IMCS simulation

antenna array, 65

Integrated Services Digital Network

See ISDN, 32

intensity, 12

interference

control-channel, 94
taking readings for, 41
type
 adjacent-channel interference, 8
 co-channel interference, 8
 control-channel interference, 8
 design consideration, 7
 mobile interference, 8

interzone handoff

definition, 151
EIMC, 18

intrazone handoff

definition, 151
EIMC, 18

IPC, 17

IPE

definition, 151
shelf for MXC, 18, 19
slot for EIMC, 18

IS-136

cellular standard, 28
definition, 151
Nokia 2160 portable, 28
radio protocol, 1

IS-54B

cellular standard, 28
definition, 151
Nokia 2120 portable, 28
radio protocol, 1

IS-641

ACELP implementation, 1

IS-641 radio protocol

definition, 151

ISDN

definition, 152
Digital Trunk Interface, 32
links to connect sites, 32
MISP, 13, 17
outgoing calls, 32
PBX connection, 32
PRA, 32

L

laptop computer, 90

link frequency calculation, 98

local power, MXC, 19

M

macrocell

description, 4
mobile interference, 8

MAT

definition, 152
description, 28
Microcellular system component, 13

MBS

antenna tables, 144
cord and cable length (diagram), 112
definition, 152
description, 20
diagram, 21
exploded view, 22

- floor mount installation (diagram), 113
 - floor mount, hybrid (diagram), 116
 - See also Microcellular Base Station.
 - wall mount installation (diagram), 114, 115
- MBS antenna tables, 143, 144, 145, 146
- MBS to antenna cabling, 143
- MCU
 - See Meridian Communications Unit.
- measuring control-channel interference, 94
- measuring path loss, 95
- measuring wheel, 90
- Meridian 1 Core software
 - definition, 152
 - description, 17
 - Microcellular system component, 13
- Meridian 1 C-Series, definition, 152
- Meridian 1 system
 - connectivity, 32
 - Digital Line Card for TCM, 122
 - Microcellular cards, 128
 - Microcellular subsystem, 1
 - MXC port connections, 118
 - SL-1 or SL-100 PBX, 32
- Meridian Administration Tool
 - See MAT.
- Meridian Communications Unit
 - AFPS Microcellular component, 13
 - definition, 152
 - TCM connection to AFPS, 28, 122
- microcell
 - concepts, 3
 - definition, 152
 - description, 4
- Microcell Deployment Data Collection, 91
- Microcellular Base Station, 126
 - count, 72
 - definition
 - Microcellular system component, 13
 - placement, 111
 - provisioning equipment for, 126
 - See also MBS.
 - TCM port connections, 118
 - terminator count, 73
- Microcellular cards, 128
- Microcellular components
 - Meridian 1 Core software, 17
 - SL-1 or SL-100 PBX, 32
 - third-party PBX, 32
- Microcellular design project, 92
- Microcellular equipment planning, 75
- Microcellular parts (table), 81
- Microcellular system
 - Automatic Frequency Planning, 30
 - capacity, 31
 - CMCP heartbeat, 30
 - CMCP monitoring, 30
 - components
 - CMCP configuration of, 30
 - hardware, 13
 - logical, 14
 - software, 13
 - diagram of, 15, 16
 - frequency management, 30
 - introduction, 1
 - Meridian 1 subsystem, 1
- Microcellular system packages
 - Option 11C, 78
 - Option 51C, 61C, 81, 81C, 77
- Microcellular Transcoder Card
 - See MXC.
- MIN, definition, 153
- MISP
 - applicable M1 systems, 74
 - definition, 153
 - description, 17
 - Microcellular system component, 13
- mobile interference, 8
- Mobile Station, definition, 153
- Mobility System Management
 - AFP feature, 28
 - definition, 153
- modem
 - CMCP connection to Meridian 1, 30
 - short-haul, 13, 27, 28
- MSM
 - See Mobility System Management.

Multi-Purpose ISDN Signaling Processor

See MISP.

Multi-Site Networking, 32

MXC

count, location per M1 system, 74

definition, 153

description, 19

M1 port connections, 118

maximum channels, 19

Microcellular system component, 13

N

neighbor cell, Microcellular system component, 14

Nokia 2120 portable, 28

Nokia 2160 portable, 28

Nokia portable telephone

programming, 38

programming menu, 39

test menu, 39

O

omni antenna, 90

diagram, 11, 25

installation, 23

ORB

See Object Request Broker.

P

partition

See cell.

path loss

description, 9

measuring, 95

PBX

connectivity, 32

definition, 154

Placement Configuration window, 47

portable

definition, 154

description, 28

IS-136 implementation, 28

IS-54B implementation, 28

microcellular system component, 13

Nokia 2120, 28

Nokia 2160, 28

number of users, 128

placing in test mode, 38

power surge protector, supplemental, 61

PPP

CMCP communications with Meridian 1, 30

definition, 154

modem connection to CMCP, 30

preliminary design and quote, 35

preliminary design report, 85

prerequisite M1 hardware, software, 75

PRI

definition, 154

PBX connection, 32

primary surge protector

definition, 154

programming the Nokia portable, 38

protocol

See radio protocol.

PSTN

CMCP connection through, 30

definition, 154

Q

Quad 4-Port Hybrid

count per cell, 70

definition, 154

description, 26

diagram, 27

limits and characteristics, 70

terminator count, 71

R

radio

See TRU-II.

Radio Line Card

See Microcellular Transcoder Card.

radio protocol

cell, 6

IS-136, 1

IS-54B, 1

IS-641, 1

receiver recommended, 89

registration

 definition, 155

 Multi-Site Networking, 32

 portable, 8

Release 23

 AFP feature, 7

Remote Power Interconnect unit, 123

reverse channel

 definition, 155

 portable to MBS, 6

RF

 cable count, 69

 channels, 30

 coverage, verifying, 97

 data collection, 91

 definition, 155

 management by CMCP, 30

 radio frequency concepts, 3

 rules, 6, 7

roaming

 definition, 155

 Multi-Site Networking, 32

RPI

 See Remote Power Interconnect Unit.

RS-232 cable, 122, 123

RSSI

 AFPS measurement, 27

 definition, 155

 plot of estimated (diagram), 55

 recording measurements, 38

 taking readings, 40

S

SAT, 27

scanning to verify RF coverage, 97

secondary power surge protector

 See supplemental power surge protector.

serial connection

 AFPS, 27, 122, 123

 maximum length, 27

serial port

 AFPS connection to MSM MAT, 122

 CMCP connection to Meridian 1, 30

service area

 diagram, 5

 Microcellular system, 4

short-haul modem, 123

 AFPS connection to MSM MAT, 27

 AFPS Microcellular component, 13

 serial connection to AFPS, 28

SID, 27, 155

signal output adjustment, 99

signal source, recommended, 89

site planning

 definition, 156

 introduction, 1

 procedure

 flowchart, 3

 steps, 2

SL-1 or SL-100 PBX, 32

software

 prerequisite M1, 75

 required for Microcellular systems, 75

 requirements, estimated, 59

spare parts, 81, 128

subsystem, Microcellular system component, 14

supplemental power surge protector, 61, 156

system configuration, steps, 59

system design

 planning, 35

 verifying, 99

system packages, 77

T

TCM cable, 122

 definition, 156

 maximum length, 27

 wiring, 117

TCM connection

 AFPS, 27

 AFPS to MCU, 28

 DLC port for AFPS, 27

 MBS to MXC port, 118

TCM, definition, 156

TDMA

- definition, 156
- radio protocol, 6

TDMA-3

- ACELP, 1, 19
- definition, 156
- voice, 19, 20, 31
- voice cells, 19
- VSELP, 19

telephone cable, 27, 123

terminator

- part numbers (tables), 84
- sizes and types, 83

terms, 147

test equipment setup, 92

test menu for Nokia portable, 39

third-party PBX connectivity, 32

traffic calculations

- for TDMA voice, 62
- TRU-II estimation, 62

traffic measurement concepts

- blocking, 12
- busy hour, 12
- Erlang B tables, 13
- grade of service, 12
- intensity, 12

transcoder

- definition, 156
- MXC, 19

TRU-II

- configured with antennas (table), 23
- count for Microcellular system, 72
- definition, 156
- in Microcellular Base Station, 20
- Microcellular system component, 13
- system hardware, 79

U

underlay, 4

Uninterrupted Power Supply

- MBS, 61
- MCU, 61

uplink

- definition, 157
- minimum RSSI, 6
- signal path, 6

UPS

See Uninterrupted Power Supply.

V

Vector Sum Excited Linear Predictive

See VSELP.

verification of design, 99

version number

See system version.

VSELP

- definition, 157
- maximum calls, 19
- MXC services, 19
- voice encoding, 1

W

wireline set

- definition, 157
- forward calls to portable, 32

Z

ZK-SAM receiver, 89

zone

- definition, 157
- Microcellular system component, 14
- zone controller, definition, 157

Meridian 1

Nortel COMPANION

Microcellular

Site planning and deployment guide

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